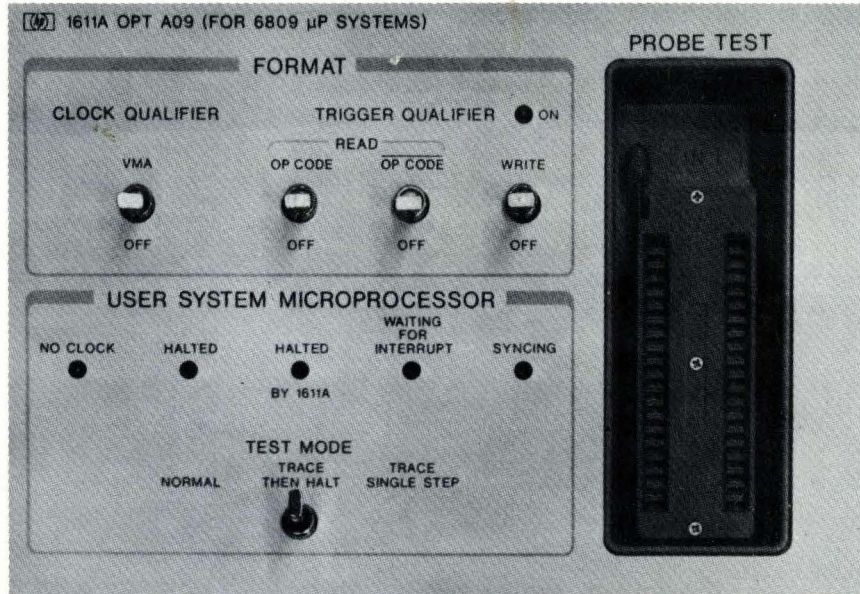


OPERATOR'S GUIDE



MODEL 1611A OPTION A09 (10266A)

PERSONALITY MODULE
FOR 6809
MICROPROCESSORS

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire green firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.



OPERATOR'S GUIDE

MODEL 1611A OPTION A09 (10266A) PERSONALITY MODULE FOR 6809 MICROPROCESSORS

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HOW TO USE THIS MANUAL

This manual is a guide for the user of the 1611A Logic State Analyzer with an Option A09 Personality Module installed. This manual describes how to install the personality module into a 1611A mainframe and then how to operate the instrument to analyze systems which use the 6809 microprocessor. Information contained in this manual is organized into the following sections and appendix:

Section I - This section provides a general description of the 1611A/Option A09 analyzer. It briefly describes its capabilities and lists its specifications.

Section II - This section describes the procedures for installing a Model 10266A Personality Panel into a 1611A mainframe to give it Option A09 capability.

Section III - This section shows the locations and describes the functions of each of the controls, indicators, and connectors on the analyzer.

Section IV - This section shows you how to set up the analyzer trace specification. It discusses the details of triggers, delays, and qualifier selections.

Section V - This section discusses in detail the procedures for making the three types of trace measurements available with the 1611A/Option A09 analyzer.

Section VI - This section discusses the procedures to follow when making a count of trigger occurrences.

Section VII - This section discusses the procedures to follow when making a measurement of a time interval in program flow.

Section VIII - This section describes a series of tests that the operator can make to verify proper operation of the 1611A/Option A09 analyzer.

Appendix A - STATUS MESSAGES - This appendix lists and defines the status messages which are displayed on the 1611A/Option A09 analyzer CRT.

SECTION I

INTRODUCING THE MODEL 1611A/OPTION A09

INTRODUCTION

The Hewlett-Packard Model 1611A Logic State Analyzer equipped with Option A09 (Model 10266A Personality Module) provides a convenient method for locating faulty system components in computer networks or systems which use 6809 microprocessors. Throughout this manual, the Model 1611A with Option A09 will be called the analyzer. The analyzer specifications are listed in table 1-1.

The Model 10266A Personality Module consists of the following components:

1. A09 Personality Board (A9).
2. A09 ROM Board (A10).
3. A09 Personality Panel (A11).
4. A09 Microprocessor Probe (A13).

The Model 10266A Personality Module can be purchased separately as an accessory to provide 1611A Logic State Analyzer mainframes with Option A09 capability.

TYPES OF MEASUREMENTS PERFORMED

The analyzer is capable of performing the four different types of measurements listed below. You can make any one of these measurements by pressing keys in the EXECUTE key group of the analyzer keyboard. The four types of

measurements allow you to gather up to four different types of data for use in analyzing your microprocessor-based instrument.

1. Capture and display blocks of program flow.
2. Capture a series of unique events (triggers) from program flow.
3. Count the number of occurrences of triggers within a block of program flow.
4. Measure intervals of time used to execute certain software routines.

READING THE ANALYZER DISPLAY

The analyzer display is divided into two parts by a dashed line. The upper part of the display contains all of the trace specifications that you set up before a run. It will not display the default selections that the analyzer makes automatically at power up, but it will show every specification that you enter from the keyboard.

The lower portion of the display is used to show the information captured in each trace for data acquisition. This portion of the display will show the captured lines of program activity, or the count of triggers found, or the count of time between any two selected points that you entered in the above trace specification.

At instrument turn-on, the display should appear as shown in figure 1-1. The ADDRESS field is open for direct entry of an address word to trigger on (inverse field to right of TRIGGER). The ENTRY key group on the analyzer keyboard

is used to make the trigger entry. The blinking cursor in the left-hand side of the inverse field shows where the character you select will be entered in the TRIGGER ADDRESS field.

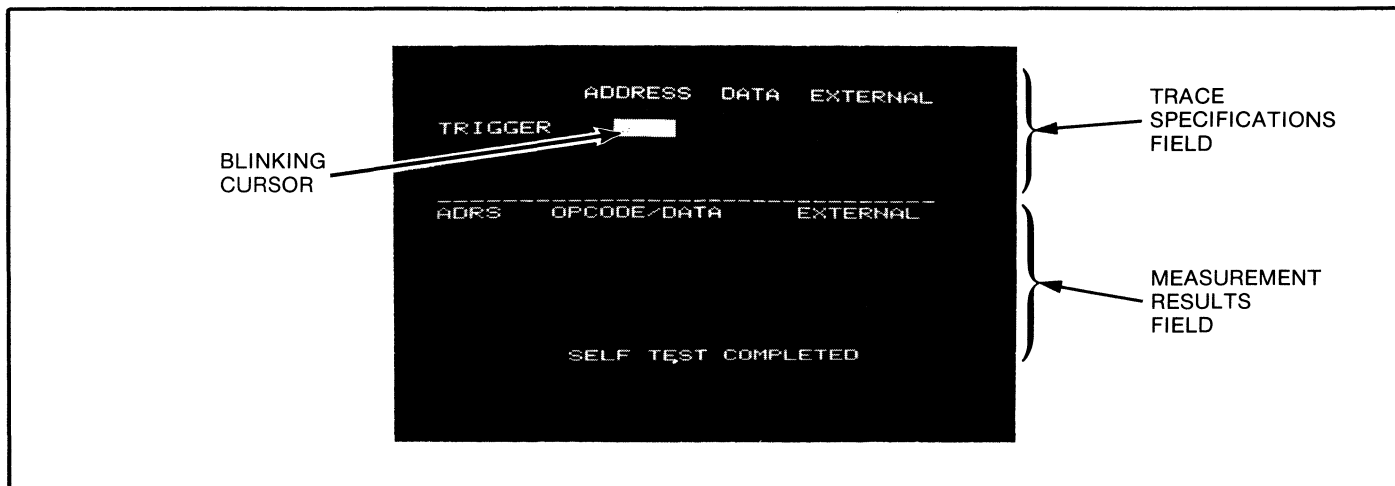


Figure 1-1. Turn-on Display

Table 1-1. Analyzer Specifications

CLOCK, DATA, ADDRESS, AND CONTROL INPUTS

CLOCK RATE: 80 kHz to 2.0 MHz when used in Models 1611A with Serial Prefix 1723A and above. 70 kHz to 1.66 MHz when used in Models 1611A with Serial Prefix below 1723A.

NOTE

If the higher clock rate is desired in analyzers with Serial Prefix numbers below 1723A, replace A7 board 01611-66507 with HP Part No. 01611-66507, REV B.

INPUT LOADING:

A0-A15, R/W: approx 1 megohm shunted by approx 40 pF, including capacitance of 30.4 cm (12 in.) connecting cable; approx 30 pF with 7.6 cm (3 in.) cable.

D0-D7, BA, BS: 20 μ A maximum with $V_{in}=2.7$ V; -0.2 mA max with $V_{in}=0.4$ V.

HALT: 120 μ A max with $V_{in}=2.7$ V; -0.2 mA max with $V_{in}=0.4$ V.

E-clock: 0.2 mA max with $V_{in}=5$ V; -0.4 mA max with $V_{in}=0.4$ V.

THRESHOLD: 2.4 V to 5.5 V, logic 1 (high); -0.8 V to 0.8 V, logic 0 (low).

SETUP TIME:

A0-A15, R/W: must be valid prior to falling edge of E-clock for at least 250 ns.

D0-D7: must be valid prior to falling edge of E-clock for at least 40 ns.

HALT: must be valid prior to rising edge of E-clock for at least 75 ns.

HOLD TIME: Halt must be valid after rising edge of E-clock for at least 10 ns. All other inputs must be valid after falling edge of E-clock for at least 10 ns.

HALT OUTPUT: TTL open-collector compatible output capable of sinking at least 8 mA when active.

EXTERNAL PROBE INPUTS

INPUT CURRENT: 50 μ A max, logic 0 or logic 1.

CAPACITANCE: approx 25 pF measured at probe tip.

THRESHOLD: 2.4 V to 5.5 V, logic 1 (high); -0.8 V to 0.8 V, logic 0 (low).

SETUP TIME: input must be present for at least 250 ns prior to falling edge of E-clock.

HOLD TIME: input must be present for at least 0 ns after falling edge of E-clock.

OUTPUTS

LOW: <0.4 V into 50 ohms.

HIGH: >2.0 V into 50 ohms (nominally 3.9 V into an open circuit).

TRIGGER OUTPUT: duration, approx 75 ns in RZ format; delay approx 400 ns after the active edge of the E-clock pulse that defines a valid trigger.

TRACE POINT (): provides a positive edge approx 400 ns after E-clock pulse that defines the specific valid trigger to be displayed on 1611A. If 1611A delay is set so that trigger word is not displayed, Trace Point

Table 1-1. Analyzer Specifications (Cont'd)

output occurs approx 400 ns after active edge of E-clock that defines the valid word immediately preceeding the first displayed word.

TRACE POINT (): complement of Trace Point ().

MICROPROCESSOR COMPATIBILITY

MOTOROLA: MC6809, MC68A09, MC68B09, MC6809E, MC68A09E, MC68B09E.

SECTION II

INSTALLATION

Inspect all parts of the Model 10266A Personality module (see figure 2-1). If your Model 10266A is incomplete or damaged, contact the nearest HP Sales/Service Office. When the Model 10266A is installed according to the following procedure, all signal connections and power requirements will be supplied by the analyzer mainframe. See figures 2-1 and 2-2 and proceed as follows:

1. Turn off analyzer LINE switch and disconnect power cord.
2. Disconnect microprocessor probe A13, and external probe A12 from rear panel (if probes installed).
3. Remove analyzer top cover by loosening captive screw in rear of top cover.
4. Disconnect ribbon cable A11W2 from A9 (figure 2-1).
5. Remove board assemblies A5, A6, A7, A8, A9, and A10.
6. Disconnect ribbon cable A11W1 from connector A1P2 on main board A1.
7. Remove screw that secured ground lug to A11 board.

8. Remove two mounting screws that secure A11 to keyboard support MP27, and remove A11 from instrument.
9. Place Option A09 Personality Panel A11 in position and secure it with mounting screws removed in step 8.
10. Secure ground lug to A11 as shown in figure 2-2.



CAUTION

Be sure that lug does not short to CRT mounting bracket.

11. Connect A11W1 into main board connector A1P2 as shown in figure 2-2. Dot on main board indicates pin 1 of connector.
12. Install A10 ROM Board and A9 Personality Board from Option A09 into main board A1 as shown in figure 2-1.
13. Connect A11W2 from Personality Panel to connector A9P3 on board A9. Location of connector pin 1 is indicated by dot on board.

14. Reinstall boards A5, A6, A7, and A8 onto main board A1 as shown in figure 2-1.

15. Connect Option A09 Microprocessor Probe A13 to A9 board through appropriate slot in rear panel and install two retaining screws.

16. Reconnect external probe A12 to A10 board through appropriate slot in rear panel and install two retaining screws.

17. Replace top cover on analyzer.

18. Reconnect power cord.

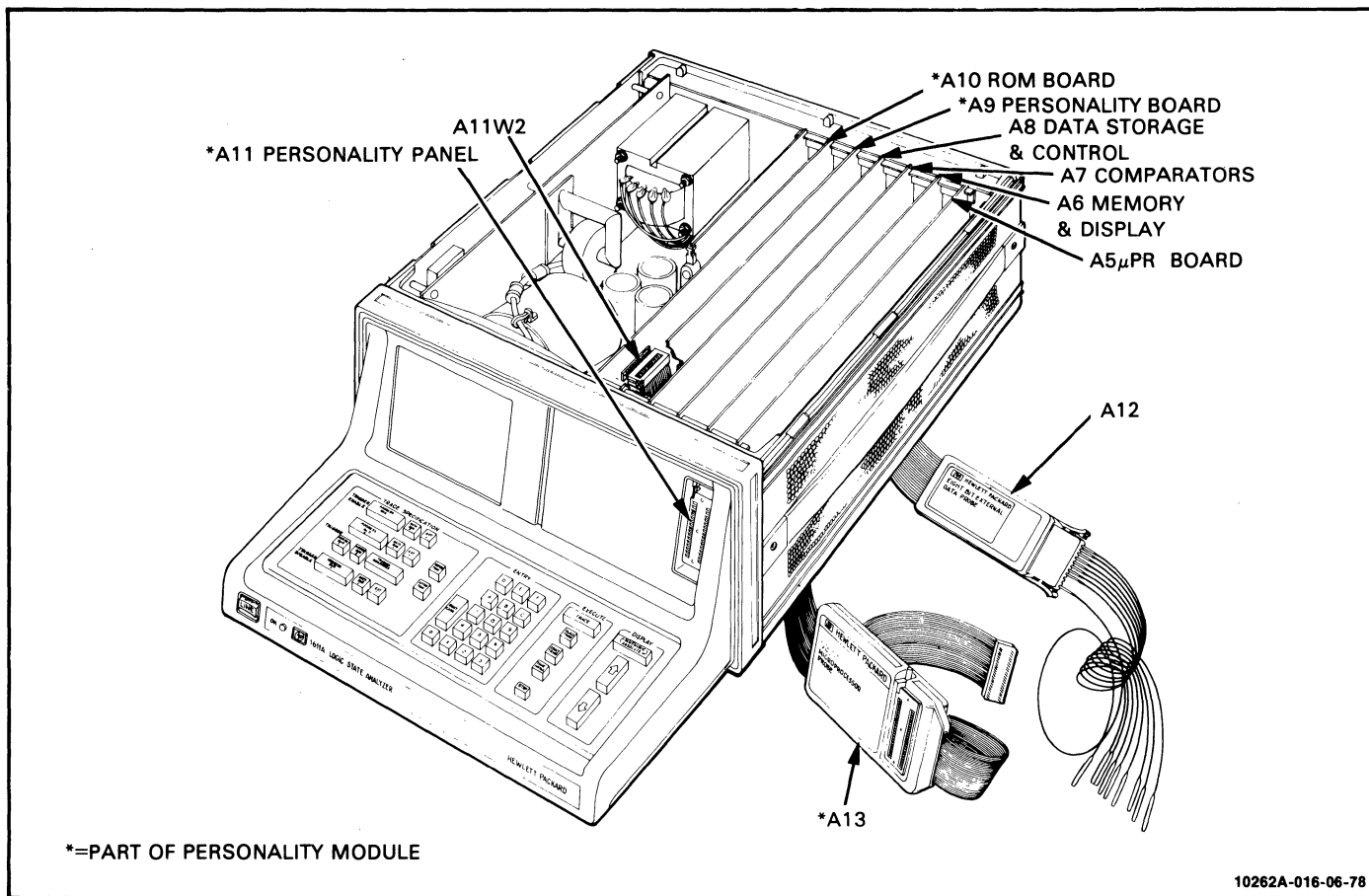


Figure 2-1. Analyzer Assembly Locations

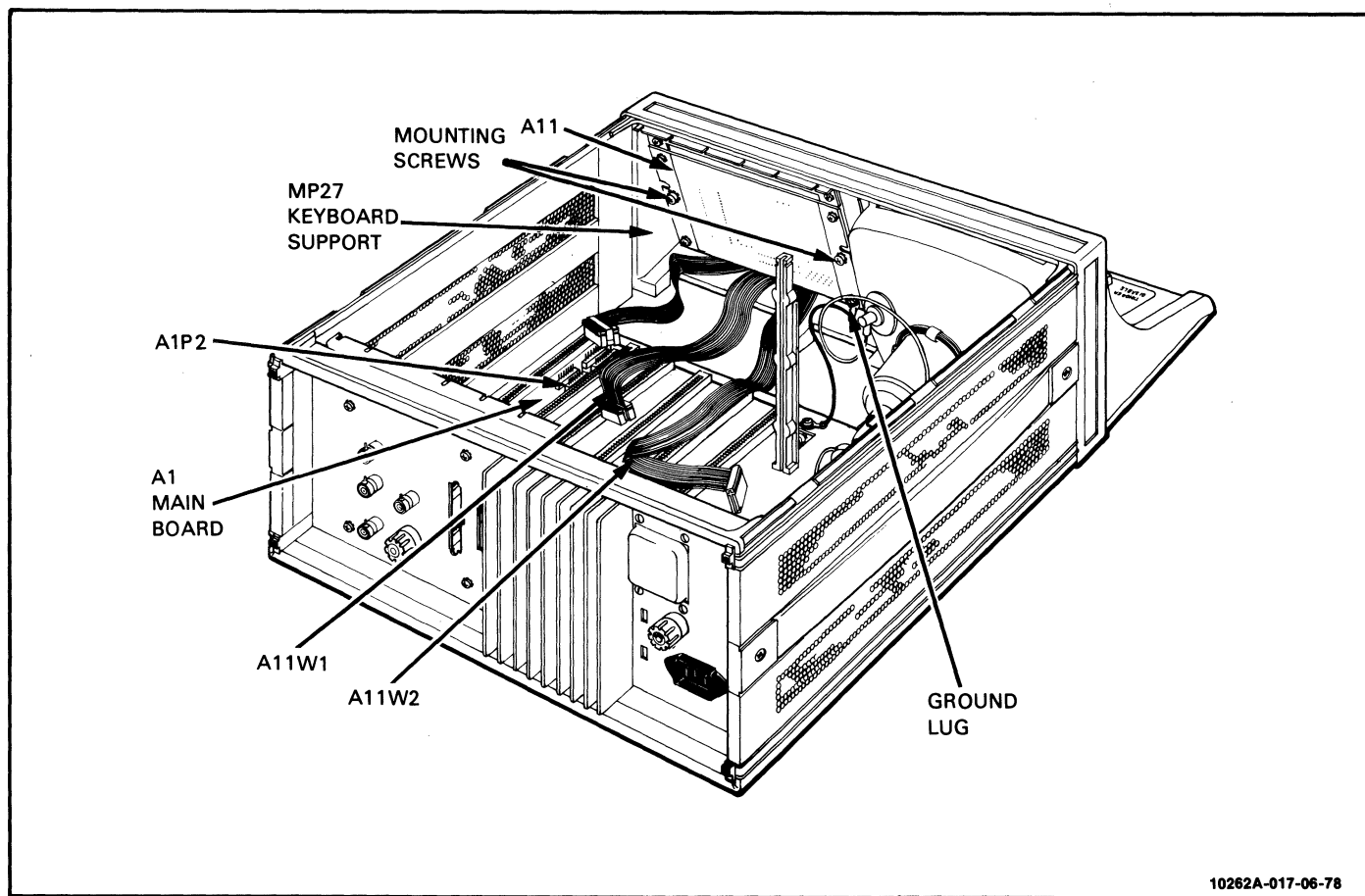


Figure 2-2. Installation of Personality Panel A11

SECTION III

ANALYZER CONTROLS, INDICATORS, AND CONNECTORS

INTRODUCTION

This section contains photographs of all of the operating controls, indicators, and connectors on the analyzer. The

function of each control, indicator, and connector is described beside the photograph where it appears.

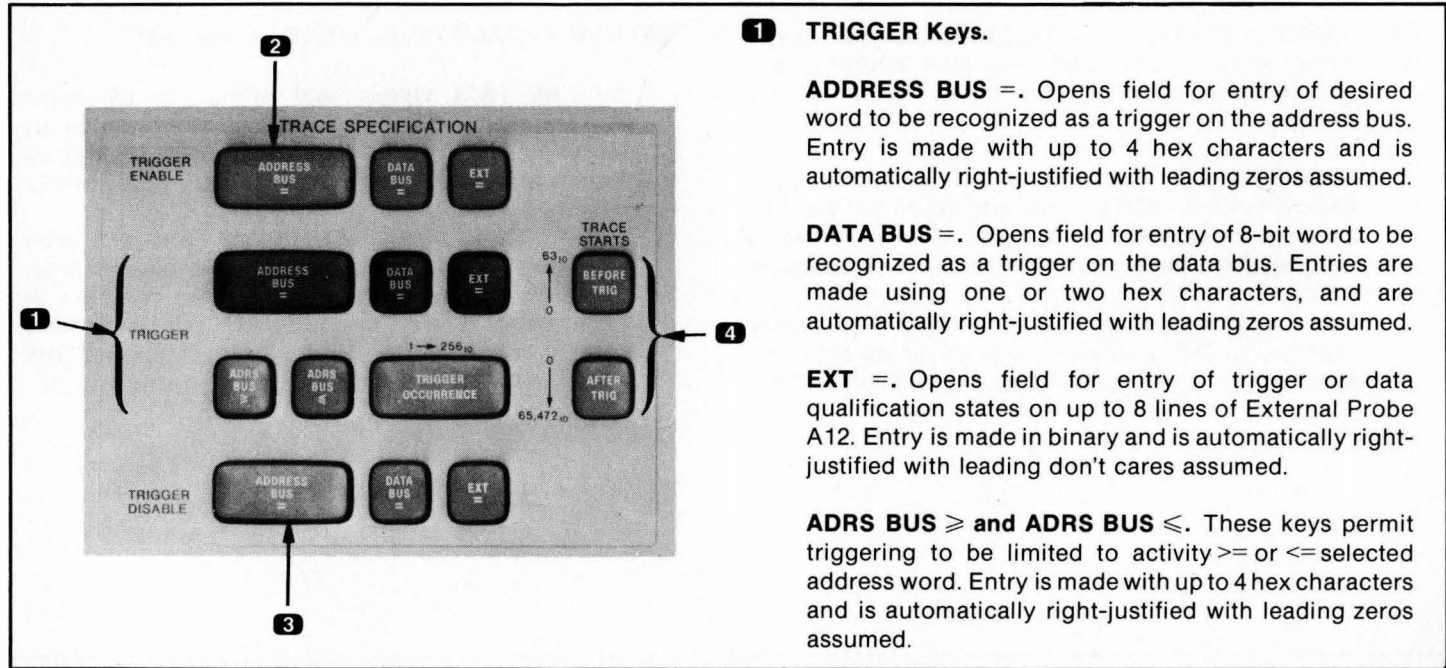


Figure 3-1. Trace Specification Key Group

TRIGGER OCCURRENCE. Used to specify a number of trigger word occurrences that must be found before the analyzer can make a trace. This field accepts decimal entries between 1 and 256. Trigger occurrence is used only in TRACE mode. (If no entry is made, field assumes a value of 1.)

2, TRIGGER ENABLE and TRIGGER DISABLE Keys.

- 3** Allow trigger recognition only after ENABLE and before DISABLE words have been found by the analyzer.

ADDRESS BUS =. Opens field for entry of trigger ENABLE or DISABLE word to be found on address bus. Entry is made with up to 4 hex characters and is automatically right-justified with leading zeros assumed.

DATA BUS =. Opens field for entry of 8-bit trigger ENABLE or DISABLE word to be found on data bus. Entries may be made with up to 2 hex characters, and

are automatically right-justified with leading zeros assumed.

EXT =. Opens field for specifying trigger ENABLE or DISABLE states to be found on up to eight lines of External Probe A12. Entry is made in binary and is automatically right-justified with leading don't cares assumed.

4 TRACE STARTS Keys. (TRACE mode only)

BEFORE TRIG. Opens field where you can enter number of transactions to be kept in analyzer memory ahead of the trigger (negative time or pretrigger). Entries are made with positive decimal number ≤ 63 .

AFTER TRIG. Opens field where you can enter number of transactions that must be counted after trigger recognition before the analyzer can start its trace (delay). Entries are made with positive decimal number ≤ 65472 . If no entry is made in the BEFORE TRIG or AFTER TRIG field, number defaults to 0.

Figure 3-1. Trace Specifications Key Group (Cont'd)

Alphanumeric keys and DON'T CARE key for making entries in open specification fields. All TRACE SPECIFICATIONS can be cleared by keeping DON'T CARE key depressed for

approximately 3 seconds. If no data field is open while you are clearing the analyzer, the message NO OPEN DATA FIELD will flash until the clear is completed.

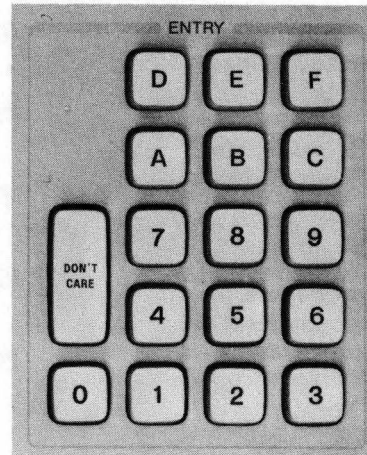


Figure 3-2. Entry Key Group

- 1 TRACE.** This key starts the trace mode which causes the analyzer to capture 64 consecutive program transactions and provide a display of microprocessor program execution.
- 2 TRACE TRIGGS.** This key initiates a run in which the analyzer captures and displays only those memory transactions that match the preselected trigger conditions.
- 3 COUNT TRIGGS.** This key initiates a mode in which the analyzer counts trigger occurrences between any selected ENABLE and DISABLE words.
- 4 TIME INTVL.** This mode produces a read-out of elapsed time between the two states defined as the ENABLE and DISABLE words. Timing measurement is made using an internal 1-MHz clock; accuracy is 0.1% $\pm 1 \mu\text{sec}$.
- 5 STOP.** Halts any execute function in progress. Analyzer will display STOPPED message along with listing activity of microprocessor system immediately prior to STOP command.

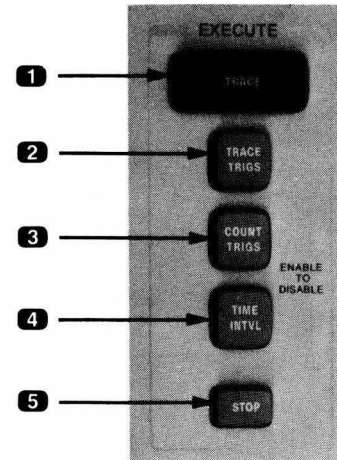


Figure 3-3. Execute Key Group

MNEMONIC/ABSOLUTE. Determines whether data will be displayed as captured (ABSOLUTE) or inverse-assembled into mnemonic statements with operands (MNEMONIC). In ABSOLUTE displays, each line represents one memory transaction with address and data words, a description of the operation performed (e.g. op code, read, write), and the states of the 8 external bits. The program statements shown in MNEMONIC often require more than one memory transaction to inverse-assemble a line. The analyzer display usually shows less than 64 lines in MNEMONIC, although data content is the same as in the 64-line ABSOLUTE display.

ROLL (↑ / ↓). Used to roll 16-line display window through analyzer memory.

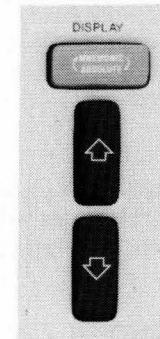


Figure 3-4. Display Key Group

LINE. Line power switch.

ON. Lamp that lights when LINE power is turned on.



Figure 3-5. Analyzer Front Rail

- 1 TRIGGER OUTPUT** (). Provides approximately 75 ns, RZ, TTL output on each occurrence of selected trigger word (useful for triggering test equipment).
- 2 TRACE POINT OUTPUT** ( / ). These outputs are levels which change state when a trace is initiated. They return to previous states when a trigger word is recognized or trace point is reached after delay. This provides a transition for triggering and a pulse for gating, or for establishing breakpoints with external logic.
- 3 LOGIC PROBE.** +5 V power connector for supplying logic probes that require less than 100 mA.
- 4 LOGIC PROBE FUSE.** 500-mA fuse for logic probe power.
- 5 MICROPROCESSOR PROBE.** Microprocessor probe connector.
- 6 EXTERNAL PROBE.** External probe connector.
- 7 LINE SELECTOR.** Slide switches for selecting 100-, 120-, 220-, or 240-Vac line operation.
- 8 FUSE.** Use 1.0-AT time-delay fuse for 100- or 120-Vac operation, and 800-mAT time-delay fuse for 220- or 240-Vac operation.
- 9 POWER INPUT.** Power cable connector.

Figure 3-6. Analyzer Rear Panel

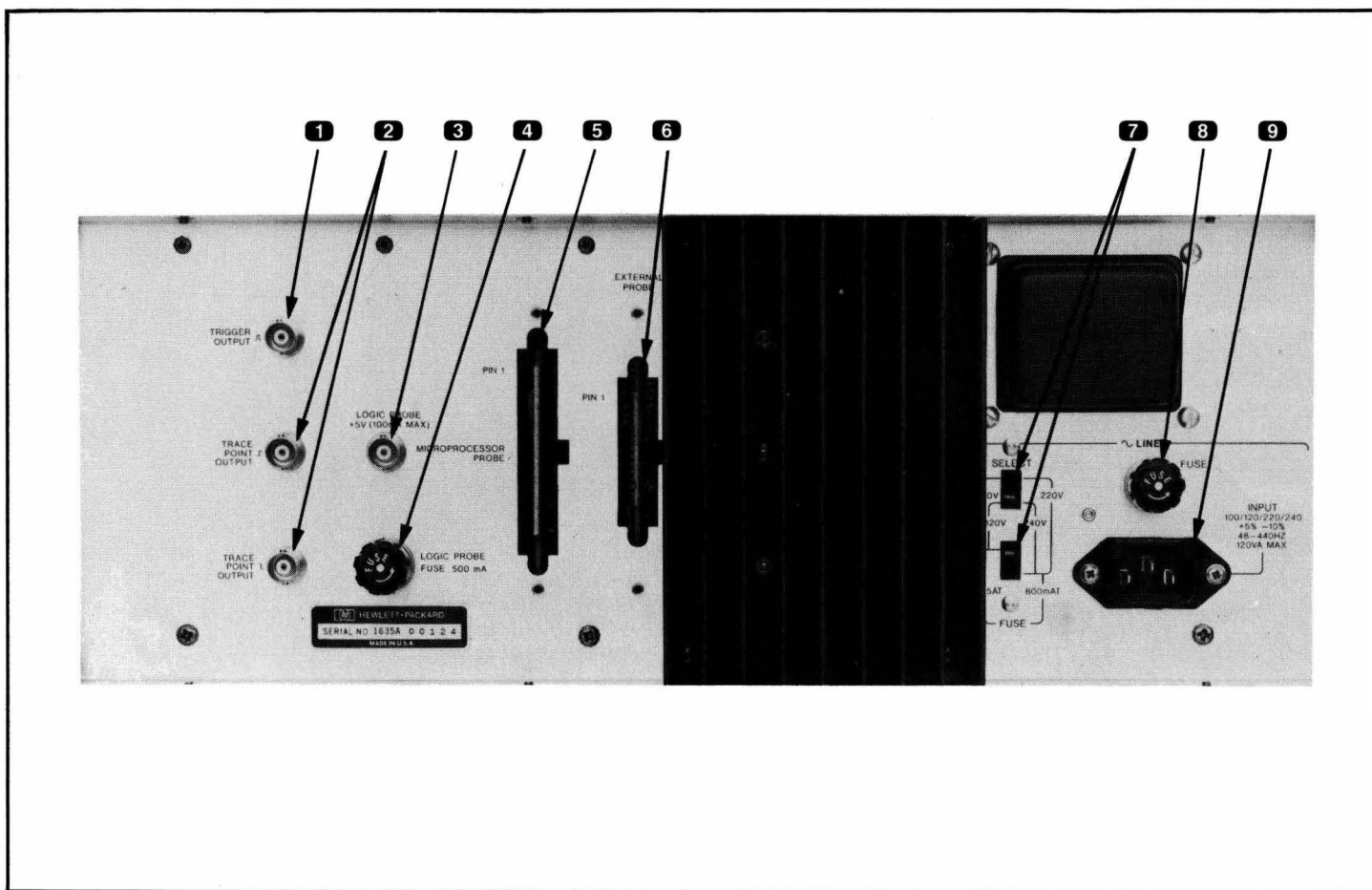


Figure 3-6. Analyzer Rear Panel (Cont'd)

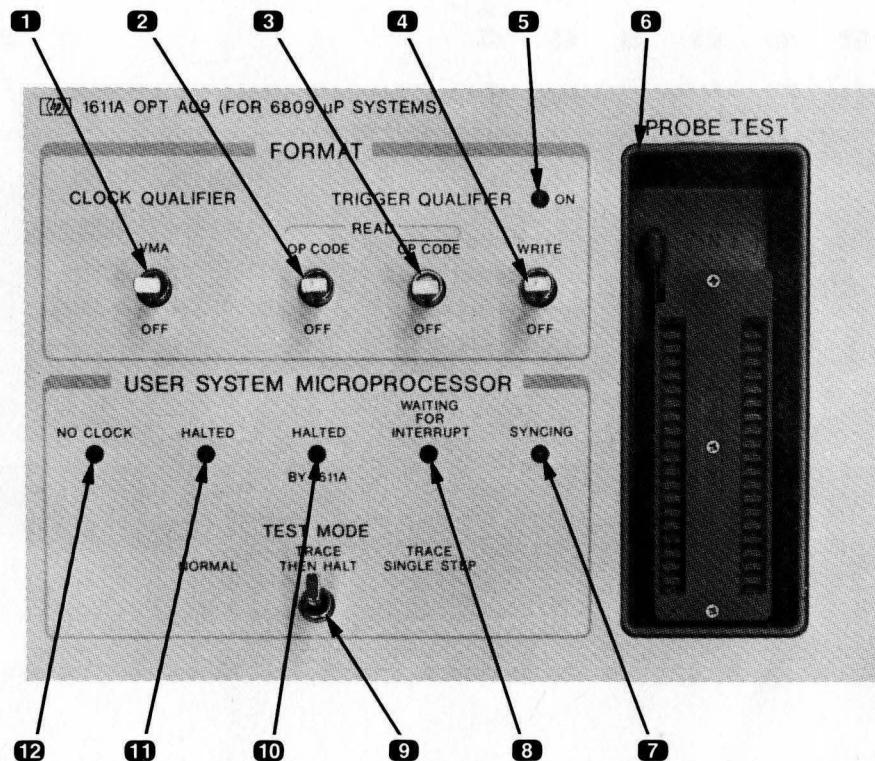


Figure 3-7. Personality Panel

1 CLOCK QUALIFIER. Can be used to define the clock periods when activity can be captured from the address and data buses and the external lines. The analyzer can be set up to capture activity occurring only during clock periods which are used for valid memory access (op code fetch, I/O read, etc), or it can be set up to capture activity during all clock periods, even those used only for performing internal functions in the microprocessor (CPU manipulation, data prefetch, etc). By selecting VMA, the analyzer will capture activity only during those clock periods which are used for valid memory access. By turning OFF the CLOCK QUALIFIER switch, the analyzer will capture the activity during every clock period.

NOTE

The microprocessor places FFFF on its address lines during non-VMA cycles. This address is also used as the second half of the microprocessor RESET address.

2 READ OP CODE. Allows analyzer to recognize its trigger only during Op-Code Fetch MPU cycles.

3 READ OP CODE. Allows analyzer to recognize its trigger only during Memory Read MPU cycles which are not Op-Codes.

4 WRITE. Allows analyzer to recognize its trigger only during Memory Write MPU cycles.

NOTE

The above three qualifier switches are arranged in an OR field. They may be set to select several combinations of MPU activity in which the analyzer will be allowed to recognize its trigger.

Figure 3-7. Personality Panel (Cont'd)

- 5 TRIGGER QUALIFIER.** Lights whenever analyzer trigger recognition is restricted to certain types of MPU cycles by any of the three TRIGGER QUALIFIER switches described above. Data acquisition and delay selections (Before and After Trigger specifications) are unaffected. If all three switches are set to OFF, this light will be out. Then the analyzer will trigger on any MPU cycle that meets the trace specification.
- 6 PROBE TEST.** Test socket for connecting microprocessor probe; provides test pattern for checking most system functions and controls.
- 7 SYNCING.** Lights when microprocessor is in the SYNCING mode (the microprocessor has executed a SYNC instruction and is waiting for an interrupt). This mode ends when an interrupt is received by the microprocessor. If it is a non-masked interrupt, the microprocessor will service the interrupt and then return to program execution. If it is a masked interrupt, the microprocessor will simply return to program execution. (In syncing mode, BA=1 and BS=0.)
- 8 WAITING FOR INTERRUPT.** Lights when microprocessor system under test executes a clear and wait for interrupt instruction (CWA). The light goes out when an interrupt is acknowledged or the system is reset.
- 9 TEST MODE.**
- NORMAL.** Data is captured and displayed without interrupting program flow in microprocessor under test.
- TRACE THEN HALT.** Analyzer executes a TRACE or TRACE TRIGS run, and when data acquisition is completed, halts microprocessor in system under test.
- TRACE SINGLE STEP.** Only one instruction cycle is executed and displayed each time you press TRACE key. In this mode, analyzer ignores your trace specification entries.
- 10 HALTED BY 1611A.** Lights when analyzer has attempted to halt microprocessor system under test (TRACE THEN HALT or TRACE SINGLE STEP modes).
- 11 HALTED.** Lights when microprocessor under test has been halted (BA=1 and BS=1).
- 12 NO CLOCK.** Lights when no E-clock from microprocessor under test is present or when E-clock period is greater than approximately 12.5 μ sec.

Figure 3-7. Personality Panel (Cont'd)

SECTION IV

SETTING TRACE SPECIFICATIONS

INTRODUCTION

The first step in making a measurement is to set up the trace specification. This section shows you how to select your trigger word, define limits within program activity where triggering can and cannot occur, establish qualifications for your trigger patterns and input clocks, and select pretrigger and posttrigger delays.

To open a data field for entry of a specification, press the associated key in the TRACE SPECIFICATION key group. Then key in the desired value from the ENTRY key group. All entries are automatically right-justified. ADDRESS and DATA fields automatically assume leading zeros, and EXTERNAL fields assume leading Don't Cares.

To change a part of your trace specification, press the associated key(s) in the TRACE SPECIFICATION group and enter the new data.

To delete a portion of your trace specification, press the associated key(s) in the TRACE SPECIFICATION group and press DON'T CARE in the ENTRY key group.

To completely default all trace specification fields, press DON'T CARE for approximately 3 seconds.

TRIGGERING

The analyzer offers you the option of specifying several kinds of trigger conditions. You may specify a trigger word that must be found on the address bus, the data bus, the external lines, or on any combination of all three inputs.

You may designate whole blocks of program flow where the analyzer can search for triggers, or where the analyzer will not be allowed to search for triggers. These blocks of program flow may be specified without regard to the addresses that are contained within the blocks.

You can specify ranges of addresses in which the analyzer will be allowed to look for triggers or in which the analyzer will be prevented from looking for triggers. These specifications will be in effect regardless of which portion of the program is being executed.

The above capabilities can all be used together to devise complex trigger specifications.

TO SPECIFY A TRIGGER WORD. The TRIGGER keys (ADDRESS BUS =, DATA BUS =, and EXT =) are used to open their respective fields within the analyzer to enter the states which you want the analyzer to recognize as triggers.

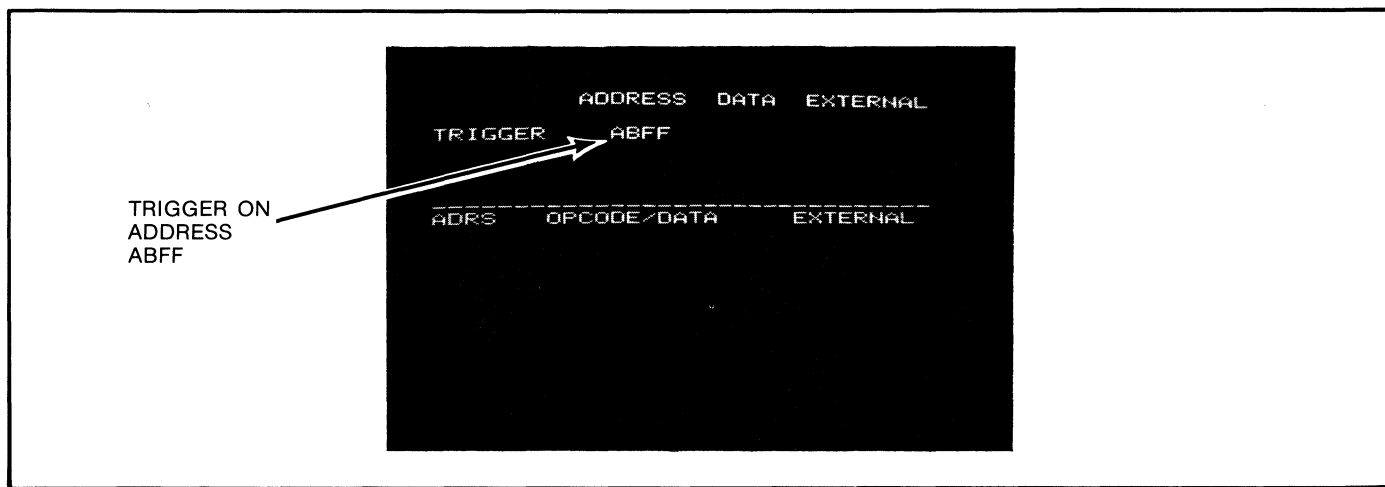
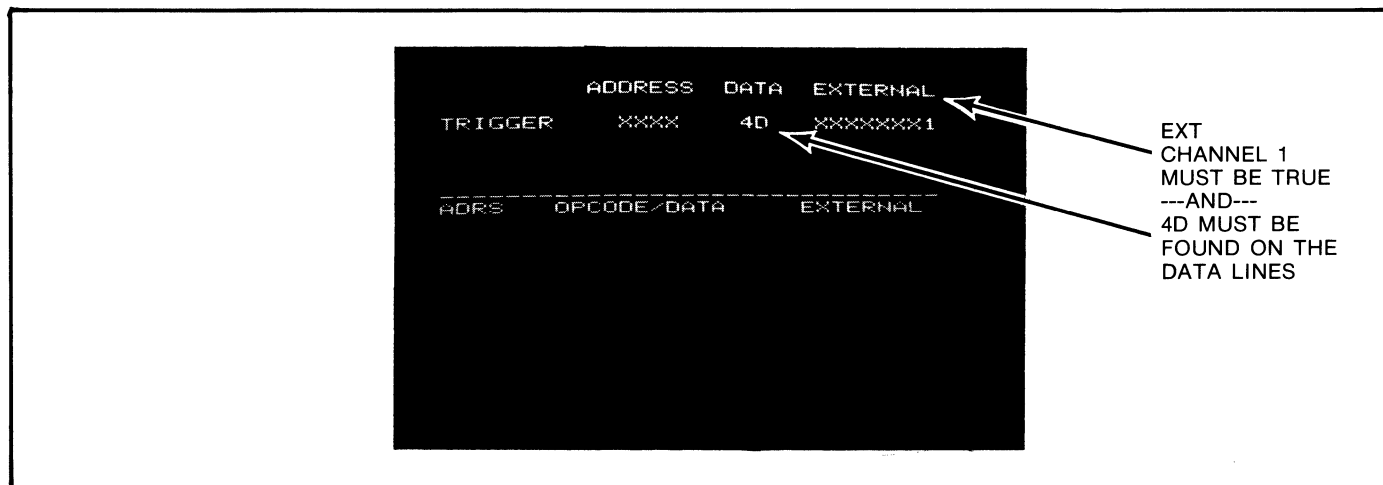


Figure 4-1. Triggering on an ADDRESS Word

Any one of these keys can be used to open the trigger field for a word on the respective bus, or two or three of these keys can be used together to specify a trigger that involves states on several buses. All requirements entered within a trigger word must be met simultaneously before the analyzer will recognize its trigger.

Pressing the ADDRESS BUS = key in the trigger key group opens the address field for entry of the above trigger word. This word must be found on the address bus before the analyzer will be triggered. The states on the data bus and the external lines do not affect the above trigger recognition.



**Figure 4-2. Triggering on a DATA Word with Qualification
on one of the External Lines**

In the above example, the trigger word may be found at any address. The DATA BUS = key in the trigger field was pressed and then the data portion of the trigger word was entered from the keyboard. Then by pressing EXT =, the external field was accessible for entry of a trigger condition

on the external lines. In the above example, line one is connected to some node, such as the read/write line. It will be used to qualify the data word. The remaining external lines have been turned off.

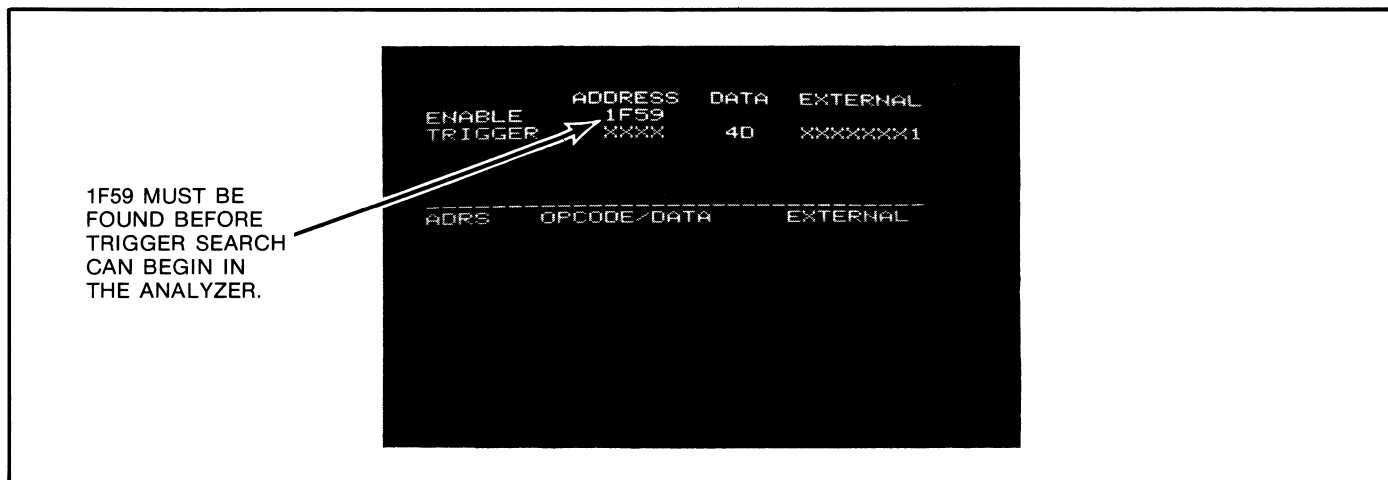


Figure 4-3. The Trigger ENABLE Entry

TO SPECIFY A WINDOW IN PROGRAM FLOW FOR TRIGGER SEARCH. In the trigger ENABLE portion of the keyboard, press ADDRESS BUS = and enter any desired address number. See the photo above. With this entry, the analyzer will turn off its trigger search until it has found the

address that you specified. You can specify that the ENABLE word be found on the address bus, the data bus, the external lines, or a combination of any of the three. When the state you specified is found, trigger search will begin in the analyzer.

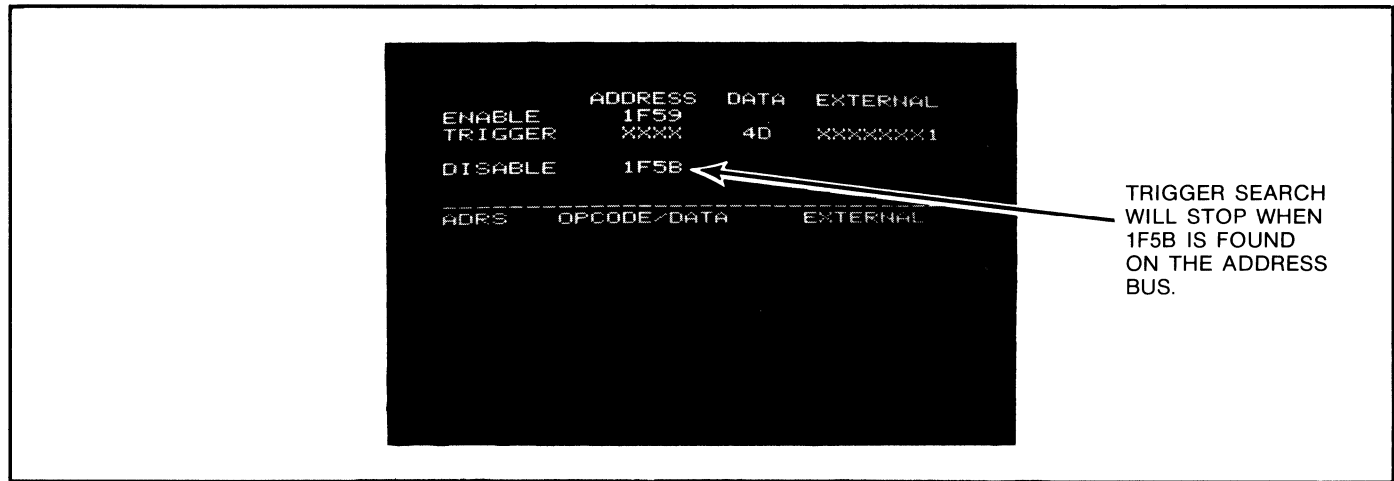


Figure 4-4. The Trigger DISABLE Entry

In the trigger DISABLE portion of the keyboard, press ADDRESS BUS = and enter any desired address word. With this entry, the analyzer will turn off its trigger search (if it is

on) anytime it finds this state on the address bus. You can specify a trigger DISABLE word on the address bus, data bus, external lines, or on any combination of these three inputs.

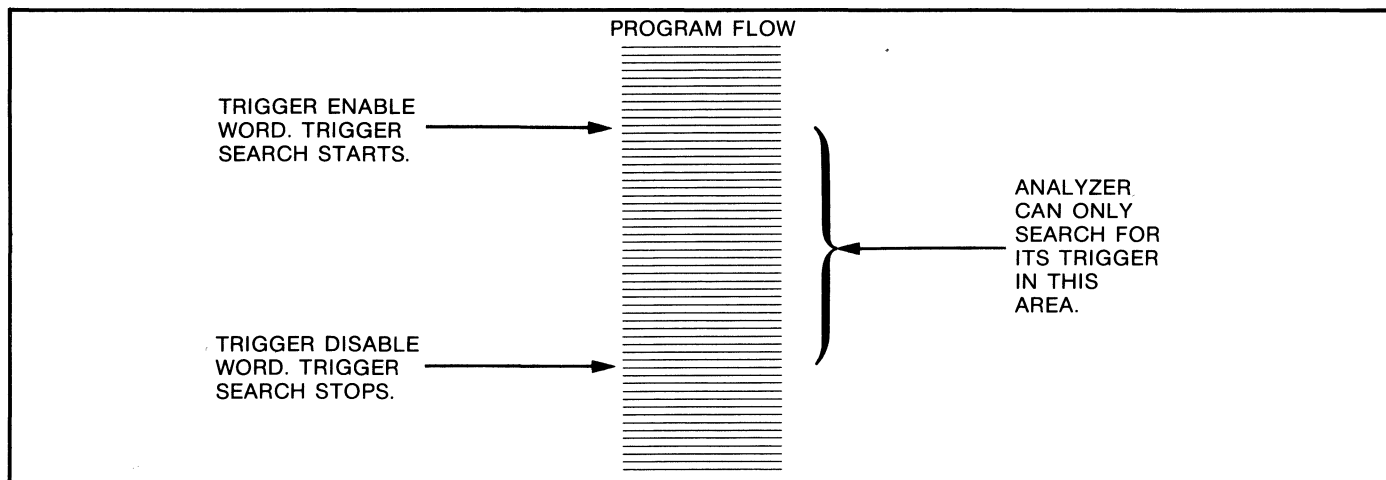


Figure 4-5. Looking for a Trigger within a Window

The trigger ENABLE and trigger DISABLE entries can be used together to specify a window within program activity where the analyzer will be allowed to look for its trigger, and

outside of which the analyzer will not be allowed to recognize any trigger.

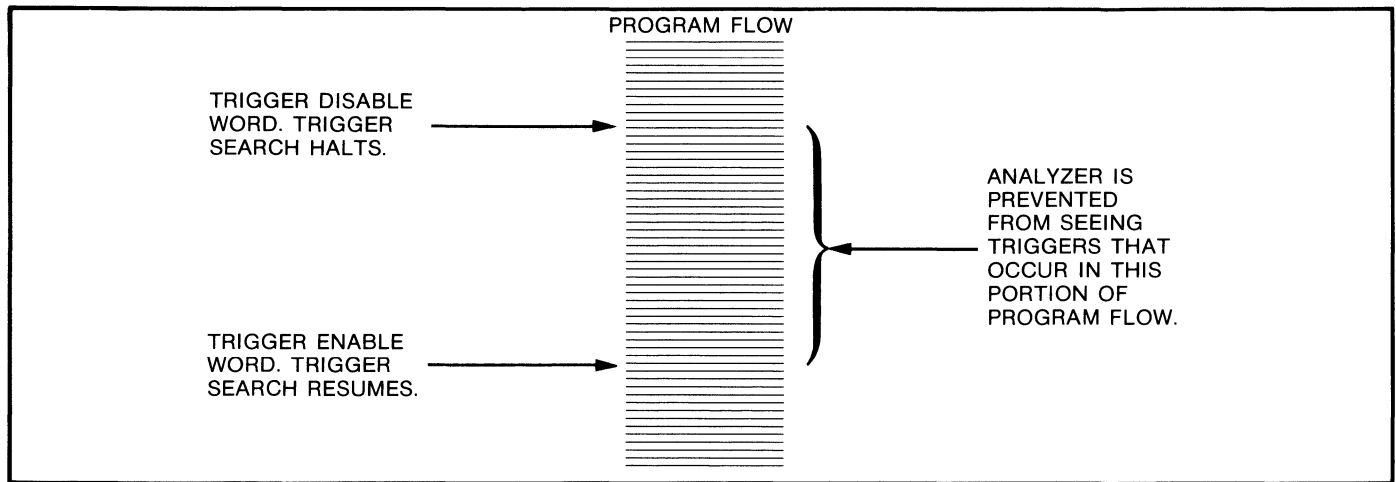


Figure 4-6. Preventing Trigger Search within a Block of Program Flow

The trigger ENABLE and trigger DISABLE specification can be used to prevent trigger recognition within a specified portion of program flow. By setting a trigger disable

condition that appears before the trigger enable condition, the trigger search in the analyzer can be inhibited during any selected block of program flow.

ENABLE, TRIGGER, AND DISABLE RELATIONSHIP. The analyzer recognizes specifications entered in the ENABLE, TRIGGER, and DISABLE fields, depending upon the status of the analyzer. To illustrate this operation, consider the case where all three entry fields are set up to recognize the same word on the address bus. The following three statements show analyzer activity under this condition:

1. The analyzer will recognize the ENABLE and TRIGGER states, simultaneously.
2. The analyzer will recognize the DISABLE and TRIGGER states, simultaneously.
3. The analyzer will not recognize both the ENABLE and DISABLE states, simultaneously. If the analyzer is already enabled, it can only recognize the TRIGGER and/or DISABLE states. If the analyzer is

already disabled, it can only recognize the TRIGGER and/or ENABLE states.

Figure 4-7 shows a program loop that you might want to examine using ENABLE and DISABLE. By setting the analyzer to both ENABLE and DISABLE on word A, you can measure the execution time of the loop, and you can count the number of transactions in the loop. When the system under test begins its first pass through the loop, the analyzer will be enabled by recognition of word A. The analyzer will make the measurement you selected until the second pass through the loop begins. Then recognition of word A will disable the analyzer. While the analyzer is disabled, it will update its display with the information just obtained. When the display is updated, the analyzer will start looking for the ENABLE word again. When the next pass through the loop begins, recognition of word A will enable the analyzer to make a new measurement.

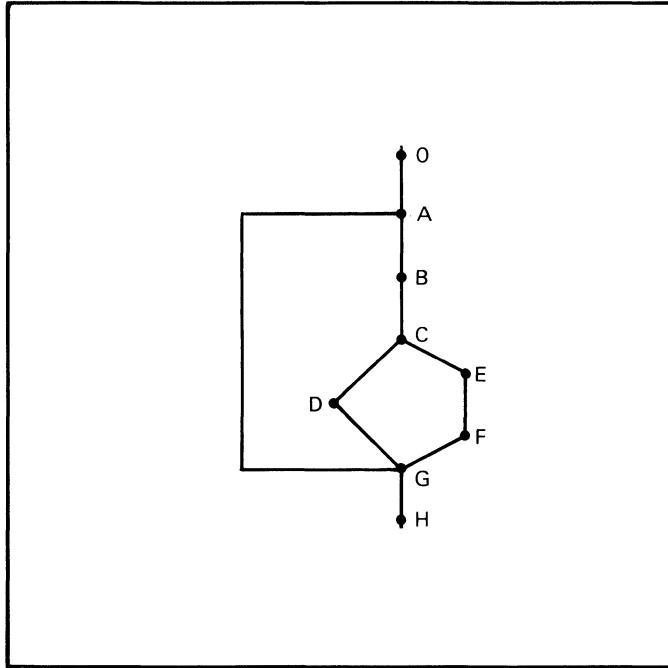


Figure 4-7. Loop Activity

While examining the loop in figure 4-7, you can use the analyzer TRIGGER specification to further define your measurements:

1. With TRIGGER = XXXX, you can press COUNT TRIGS and the analyzer will count every state in the loop, plus 1 (word A will be counted twice). You might use this trigger specification to find out if the loop executes the same number of states on each pass.
2. Now if you press TIME INTVL, the analyzer will measure how much time the system takes for each execution of the loop (from word A to the next occurrence of word A). You might use this measurement to see if loop execution time is consistent. The TRIGGER entry has no effect upon time measurements.
3. By changing the ENABLE word to 0, DISABLE word to H, and TRIGGER word to A, the analyzer will count the number of passes that the system makes through the loop when it executes the program. You might use this trigger specification to see how many times the loop is executed if certain conditions are present during a run of the program.

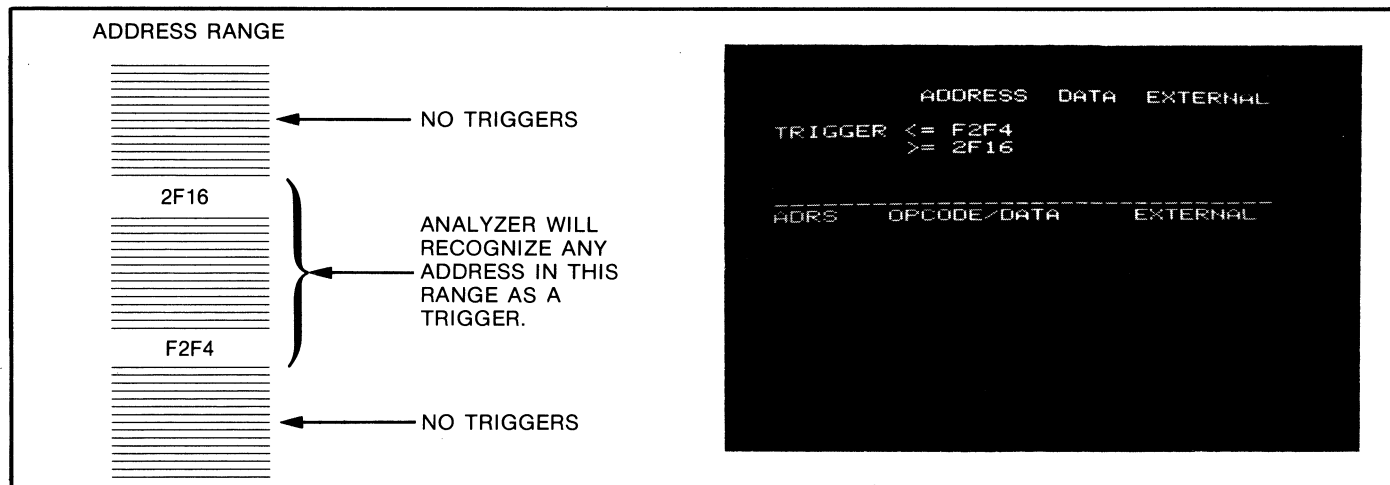


Figure 4-8. Triggering Within a Range of Addresses

TO SPECIFY ADDRESS RANGES FOR TRIGGERING. The ADRS BUS $\geq$ and ADRS BUS $\leq$ keys are used to establish ranges of addresses in which every address will be recognized as a trigger. When you press the ADRS BUS $\geq$ key and enter a number, the analyzer will then recognize as a trigger any address on the address bus which is the same as the number you entered, or larger (up to FFFF).

When you press the ADRS BUS $\leq$ key and enter a number, the analyzer will then recognize as a trigger any address on the address lines which is equal to the number you entered, or lower (down to 0000).

The ADRS BUS $\geq$ and ADRS BUS $\leq$ keys can be used together to establish a window of addresses which will all be recognized as triggers by the analyzer.

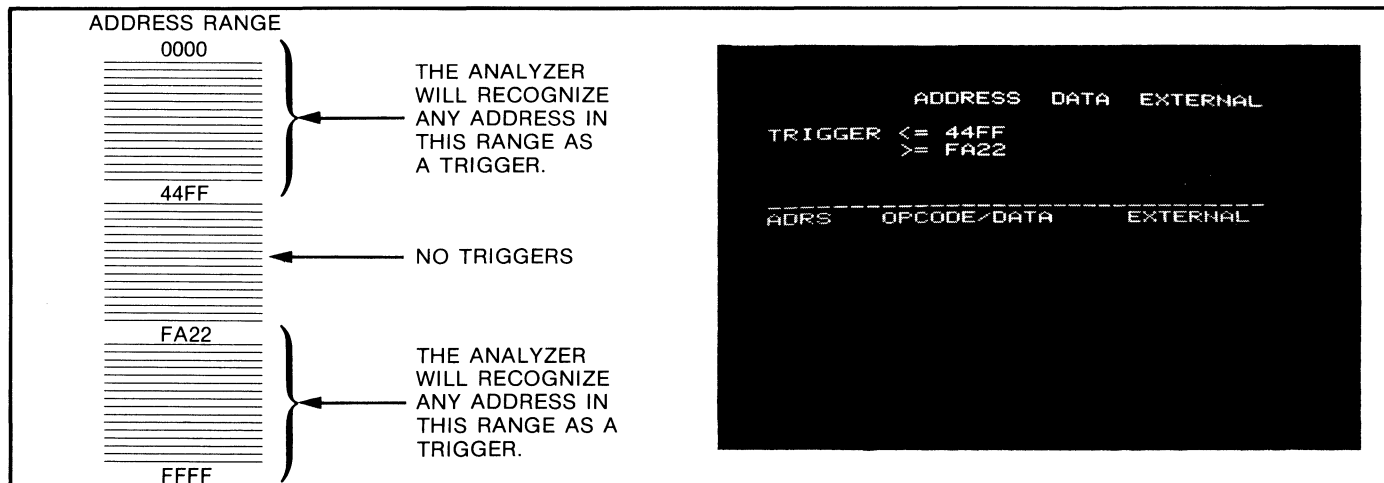


Figure 4-9. Triggering Outside a Range of Addresses

Now press ADRS BUS $\geq$ and enter FA22 from the keyboard. Then press ADRS BUS $\leq$ and enter 44FF from the keyboard. With this setup, the analyzer will recognize any address from

FA22 to FFFF as a valid trigger, and any address from 44FF to 0000 as a valid trigger. The analyzer will not be able to recognize any address between 44FF and FA22 as a trigger.

TRIGGER QUALIFICATION

Trigger conditions which you specify can be restricted to particular types of microprocessor machine cycles by using the TRIGGER QUALIFIER switches on the personality panel. With all three of these switches set to OFF, all machine cycles will be qualified. By turning on any of the switches, trigger recognition will be restricted to the chosen condition.

By turning on the READ OP CODE switch, the analyzer will only be able to recognize those triggers that occur during machine cycles which are used to read valid op codes.

By turning on the READ $\overline{\text{OP CODE}}$ switch, the analyzer will only be able to recognize triggers that occur during a read cycle which is not used to read an op code (read an operand, etc).

By turning on the WRITE switch, the analyzer will only be able to recognize those triggers that occur during machine cycles which are valid write operations.

NOTE

The READ OP CODE, READ $\overline{\text{OP CODE}}$, and WRITE switches are arranged in an OR pattern. You can turn on more than one of these at a time to establish several conditions in which the analyzer will be allowed to search for and recognize its trigger.

TRIGGER DELAY

Two types of key entries can be made on the analyzer when you are selecting a trace delay: the TRIGGER OCCURRENCE entry, and the TRACE STARTS BEFORE TRIG/AFTER TRIG entry. These allow you to delay traces until after a number of triggers have been found, or until after a number of transactions have occurred. These also enable you to capture a specified number of states leading up to your trigger word and a number of states following your trigger word both in the same trace. The delay capabilities offered in the analyzer are shown in figure 4-10 and described in the following paragraphs.

The TRIGGER OCCURRENCE key is used to open the occurrence field. This field allows you to change the delay-by-triggers specification. You can enter any number between 1 and 256 in this field. This entry will tell the analyzer how many times it must find the trigger you specified before it can begin to acquire its trace. At power-up, this field assumes a value of 1, causing the analyzer to begin its trace at the first occurrence of the trigger word.

To obtain a delay by counting transactions, press one of the TRACE STARTS keys. You may select either the BEFORE TRIG or the AFTER TRIG function, but not both.

If you wish to capture the activity leading up to your trigger word, press BEFORE TRIG and enter the number of transactions that you would like to see ahead of your trigger. You can specify any number from 0 to 63 transactions of BEFORE TRIG delay. This allows you to capture and observe up to 63 lines of activity preceeding the trigger word.

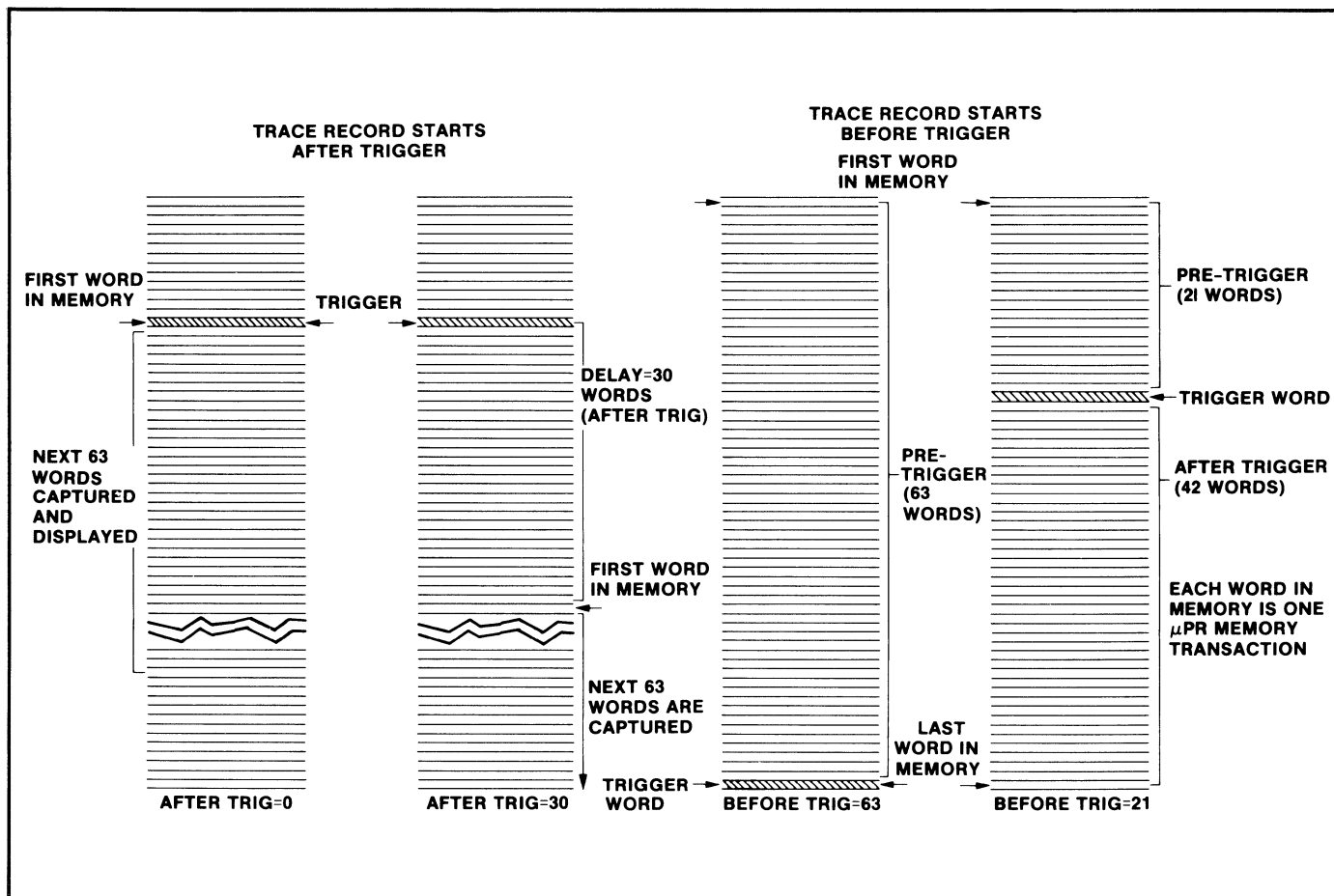


Figure 4-10. Before Trigger/After Trigger Activity

You may obtain a partial display (less than 64 transactions stored in memory) when using a BEFORE TRIG specification as part of the trace specification. This is because the analyzer processes a BEFORE TRIG specification by counting the number of transactions after the trigger (not before). If you enter BEFORE TRIG = 60, then the analyzer will complete its run by placing every transaction in memory as it arrives, finding its trigger, and then capturing three more transactions before stopping. If at least 60 transactions occurred before the trigger was found the analyzer will have a full memory ($60+1+3=64$), but if only 15 transactions occurred before the analyzer found its trigger, then its memory will have only 19 transactions (15 of pretrigger, the trigger, and 3 of posttrigger). In this case, the roll keys in the display group will only allow you to access the 19 lines obtained. You will not be able to view the rest of memory.

If you wish to obtain a trace of activity that does not start until some time after the trigger, you can set the analyzer to count from 0 to 65 472 qualified clock periods after it recognizes the trigger before it begins to collect its 64 transactions in memory. In this case, the trigger word will not be stored in memory. At power up, the TRACE STARTS (BEFORE TRIG or AFTER TRIG) field is set to 0 so that the trigger word will be the first word in memory.

CLOCK QUALIFICATION

By setting the CLOCK QUALIFIER switch to VMA, the analyzer is only allowed to recognize those machine cycles which are used for valid transfer of data to and from locations in memory and I/O; it cannot recognize clocks which are used to perform operations within the microprocessor (add the content of two registers, move data from one register to another, etc). This switch allows you to collect 64-line blocks of activity with CLOCK QUALIFIER set to VMA until a failure is found. Then the area around the failure can be examined in greater detail by turning off the CLOCK QUALIFIER switch and collecting bus activity during every clock cycle.

NOTE

The CLOCK QUALIFIER switch directly affects the number of triggers that will be counted in a count triggers measurement. With a setup of TRIGGER = XXXX, the analyzer will count only the VMA transactions with CLOCK QUALIFIER set to VMA, and all transactions with CLOCK QUALIFIER OFF.

SECTION V

MAKING TRACE MEASUREMENTS

INTRODUCTION

The analyzer offers three variations for making trace measurements of program activity: Trace mode, Trace Triggers mode, and Trace Triggers End On Disable mode. Each of these three trace modes offers different capabilities and requires slightly different setups and operating procedures. The three trace modes are discussed in detail in this section.

TRACE MODE. In this mode, the analyzer searches for the trigger conditions that will satisfy the specification you entered (trigger words, delay, and qualifiers). When the trace specification is satisfied, the analyzer captures the activity on the monitored lines (address bus, data bus, and eight external lines) during 64 consecutive qualified clock cycles.

TRACE TRIGGERS MODE. In this mode, the analyzer performs the same as it did in the trace mode above. The only difference is that instead of capturing 64 consecutive transactions, the analyzer will capture the first 64 transactions that match your trigger specification. You might use this mode to capture only write operations from a block of memory to verify that proper data was entered. To do that,

you would set up your analyzer to trigger on the desired block of memory and use the WRITE TRIGGER QUALIFIER on the personality panel to qualify only write transactions.

TRACE TRIGGERS END ON DISABLE MODE. In this mode, the analyzer captures transactions that match your trigger until it finds the DISABLE word you specified. Then the analyzer halts data acquisition. It does not capture the DISABLE word. This mode is used to capture a continuous run of qualified transactions preceeding some point in an operating program. Trace triggers end on disable measurements can result in partial displays. These occur when the analyzer finds less than 16 triggers before it finds the DISABLE word that ends the run.

NOTE

Model 1611A mainframes with serial prefixes below 1723A can not do trace triggers end on disable runs. To modify these mainframes for this capability, remove board A8 (HP Part No. 01611-66508), and replace with A8 (HP Part No. 01611-66535).

SETUP FOR A MEASUREMENT

Follow all of the steps below as they apply to the measurement you intend to make:

1. Connect microprocessor probe A13 to the 6809 microprocessor you are going to test. Use either method a or method b described below for making these connections:
 - a. Remove microprocessor from circuit or assembly under test and install it in socket on microprocessor probe A13. Then connect cable with 40-pin connectors from microprocessor probe to circuit or assembly where microprocessor was removed.
 - b. If you do not use step a above, leave microprocessor installed in its circuit or assembly. Then connect 40-pin clip from microprocessor probe A13 directly to contact pins on the 6809 assembly.
2. Connect external probe channels to points which are to be monitored or used for trigger qualification, if desired. Each channel can be connected through a separate wire. Be sure to ground the probe through the appropriate wire. The probe channels are

numbered on the probe label. These numbers correspond to locations on the analyzer display.

3. Turn on analyzer LINE power switch. The ON lamp should light.
4. Specify trigger word desired for your run. Refer to Section IV for a discussion of trigger word selections.
5. Specify window in program flow for your trigger search, if desired. Refer to Section IV for details.
6. Specify address range for triggering, if desired. Refer to Section IV for details.
7. Select trigger qualifiers on personality panel A11, if desired. Refer to Section IV for details.
8. Select desired trigger delay. Refer to Section IV for details.
9. Select desired clock qualification on personality panel A11. Refer to Section IV for details.
10. If you are making a trace triggers end on disable measurement, modify the above setup by specifying BEFORE TRIG = 63. This places the DISABLE word at the end of your 64-word memory.

EXECUTING A TRACE MEASUREMENT

This procedure describes the steps to follow when making a normal trace, trace triggers, or trace triggers end on disable measurement. Note that not all of these steps will apply to every measurement. Those steps that are unique to only certain kinds of measurements have been noted.

1. On personality panel A11, set TEST MODE switch to select the desired mode for running the test.
 - a. Use the NORMAL position if you are going to capture data from a system during real-time operation, without interruption of program flow.
 - b. Use the TRACE THEN HALT position if you want to stop program flow in the system under test after you have acquired your information in the analyzer memory.
 - c. Use the TRACE SINGLE STEP position if you want the analyzer to stop program flow in the system under test each time that it executes a single transaction. You will have to press the TRACE key each time you want to capture another transaction. This operating mode is only available during TRACE measurements. It can not be used for TRACE TRIGS measurements.
2. If you are going to perform a regular trace measurement, press the TRACE key on the analyzer

keyboard. If you wish to make a continuous-run series of traces, hold the TRACE key until CONTINUOUS appears on the analyzer display, approximately 2 seconds.

3. If you are going to perform a trace triggers or trace triggers end on disable measurement, press the TRACE TRIGS key. If you wish to make a continuous-run series of measurements, hold the TRACE TRIGS key until CONTINUOUS appears on the analyzer display, approximately 2 seconds.
4. When the run begins, WAITING FOR ENABLE will flash on screen until the ENABLE word is recognized (if entered). Then WAITING FOR TRIGGER will flash on screen until the trigger specification has been satisfied. (In trace triggers end on disable runs, WAITING FOR TRIGGER will be replaced by TRIGR OCCUR = 0).

NOTE

WAITING FOR ENABLE and WAITING FOR TRIGGER may alternate on the display. This occurs when you have specified both an ENABLE and DISABLE word, and the trigger is not found between them (the analyzer searches for ENABLE, finds it, searches for trigger, does not find it, finds DISABLE, and searches for ENABLE again).

5. During TRACE and TRACE TRIGS measurements, after the analyzer has detected at least one trigger, but before the measurement is complete, two messages may be displayed: TRIGR OCCUR=, and DELAYING. TRIGR OCCUR = shows the number of trigger occurrences that have been found during the run in progress. DELAYING appears on screen after the trigger specification has been met but before the trace is complete.
6. During trace triggers end on disable measurements, the message TRIGR OCCUR => 64 may appear on screen. This message is generated in response to one of two conditions: (1) when 64 triggers are detected before the DISABLE word is detected; and (2) the analyzer does not contain the trace triggers end on disable modification (1611A serial prefix below 1723A).
7. If you are making a continuous-run measurement, press the TRACE or TRACE TRIGS key (as applicable) again to return to normal operation.
8. The information below the dashed line on the display will not be updated until data acquisition has stopped,

trace complete. When the trace is complete, the first 16 lines of the memory will be displayed and LINE 0 will appear in the heading. Now you can roll the 16-line display window through the analyzer memory using the roll keys in the DISPLAY key group.

9. If you press the STOP key while a run is in progress, the analyzer will display the message STOPPED along with the content of its incomplete memory. You will be able to obtain display of that portion of memory that was acquired during the run, but you will not be able to see the area of memory that did not gather new data during the run. If you pressed STOP before any new information had been gathered into memory, the information portion of your analyzer display would be blank.
10. While a run is in progress, if you press any key on the analyzer that is outside the EXECUTE key group (such as MNEMONIC/ABSOLUTE or ADDRESS BUS=), the run will be aborted. In this case, you will not be able to access any of the memory. If you attempt to obtain a display of memory, the analyzer will place the message RUN ABORTED, NO DISPLAY CHANGE on screen.

USING THE TRACE THEN HALT AND TRACE SINGLE STEP CAPABILITIES

The TEST MODE switch on the personality panel offers two positions other than NORMAL for performing tests on a microprocessor system. One is TRACE THEN HALT and the other is TRACE SIGNAL STEP. These two test modes add a great deal of capability that you can use when checking software activity with the analyzer.

USING TRACE SINGLE STEP. Consider the case where a program fails each time it executes some sort of activity. The TRACE SINGLE STEP test mode will allow you to single step through that activity to see exactly which operation is causing the failure. Each time you press the TRACE key, the analyzer will allow the 6809 microprocessor under test to run through one program step (this may involve several bytes of bus activity). When the 6809 microprocessor under test has executed the bytes of the instruction, it will again be halted by the analyzer so that you can examine the transfers of data that resulted from the program step just performed. If the program step was executed correctly, you can again press the TRACE key and allow the 6809 microprocessor under test to execute another program step. You can continue this process (press TRACE, allow execution of one step) until the

6809 microprocessor does reach the point where program failure occurs.

USING TRACE THEN HALT. Now consider the case where the failure is occurring deep within a very long program. It would be time-consuming to single step from the beginning of the program all the way through to where the failure finally occurs. The TRACE THEN HALT capability can eliminate this inconvenience. When you use this test mode, your program runs at real time execution until the analyzer memory is filled. Then the analyzer activates the 6809 halt line. You can set up the analyzer to trigger when some unique state just ahead of the problem area occurs. The analyzer will automatically halt microprocessor program execution when it detects the point you specified so you can switch over to TRACE SINGLE STEP and step through the program instructions in question.

To use the TRACE THEN HALT test mode in the above application, set up the analyzer to trigger on some event ahead of the area where your program fails. By selecting a BEFORE TRIGGER specification of 63, the analyzer will halt the system under test as soon as it detects the trigger word you specify. Then you can switch to TRACE SINGLE STEP, and begin stepping through the program instructions in question.

TRACE THEN HALT TRIGGERING. Now consider the case where your program fails just when the system under test exits a program loop. You would like to single step through the last execution of that program loop and watch what happens when the system exits the loop. Perhaps the program failure occurs on the first transaction after the loop. You can't trigger on that state because the failure will have already occurred by the time that the analyzer halts the 6809 under test. You can't trigger directly on any state in the loop because those states repeat themselves each time the loop executes. One approach to solving this problem is described in the next paragraph.

If the loop in question is executed the same number of times in every program run, you can set up the analyzer to trigger on some unique state within the loop. Then enter a delay by TRIGGER OCCURRENCES that is slightly less than the number of loop executions that will be performed. If the number of loop executions varies according to external conditions, try to set up conditions that will obtain a fixed number of loop executions. Up to 256 loop executions of delay can be specified using the TRIGGER OCCURRENCE delay. When the analyzer halts the 6809 microprocessor under test, you can switch to TRACE SINGLE STEP and use the TRACE key to step through the remaining instructions of loop activity and observe what happens when the system exits the loop.

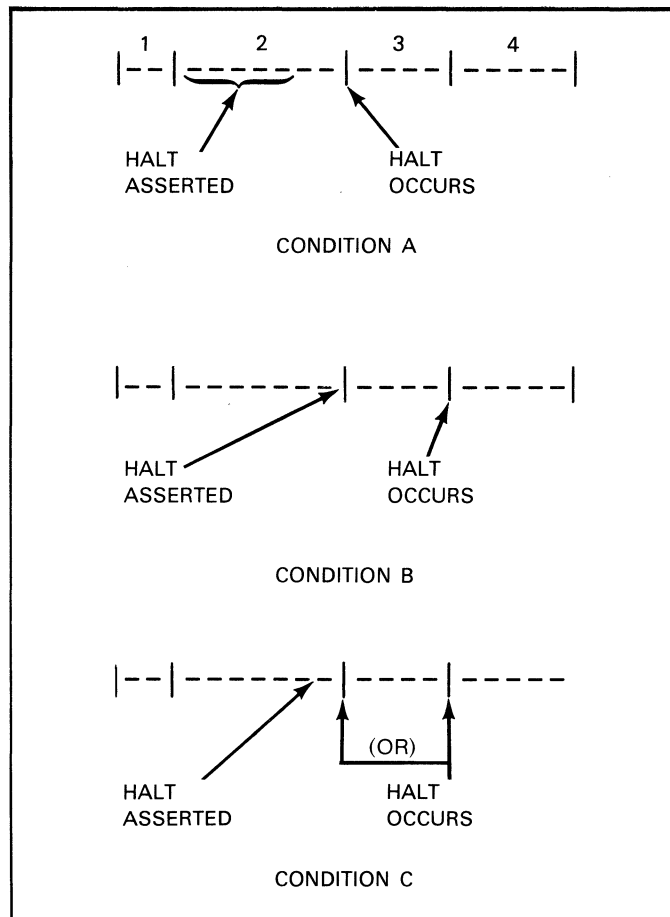


Figure 5-1. Halting 6809 Under Test

STOPPING THE PROGRAM WITH TRACE THEN HALT.

Figure 5-1 shows four instructions in the flow of a 6809 program. It is included here to illustrate the response of the 6809 when the analyzer asserts its halt line. In this figure, the first program instruction is two clock cycles long, the second is seven clock cycles long, etc. The analyzer will assert the 6809 halt line when it obtains the 64th byte into its memory.

Condition A of figure 5-1 shows what happens when the analyzer asserts the halt line more than two clock cycles before the end of the instruction being transacted. In this case, the 6809 microprocessor under test has time to detect the asserted halt line before the end of the present instruction. It will halt when it completes execution of the present instruction.

Condition B of figure 5-1 shows what happens when the analyzer asserts the halt line at the end of the last clock cycle in the instruction being executed. In this case, there is not enough time for the 6809 microprocessor under test to detect the asserted halt line before the end of the present instruction. It will execute the next instruction word before halting.

Condition C of figure 5-1 shows what happens when the analyzer asserts the halt line one clock cycle before the last clock cycle in the instruction being executed. Whether or not

the 6809 microprocessor under test will have time to detect the asserted halt line and stop at the end of that instruction will depend upon the system clock rate. It will be difficult to predict.

The best way to keep from missing program steps that you want to single-step through is to use additional pretrigger delay. Try a pretrigger of 10 or 20. This will ensure that the 6809 microprocessor under test will halt several instructions before it reaches the area you want to examine. Then you can step through these extra instructions by using the TRACE key and TRACE SINGLE STEP test mode.

INTERPRETING THE DISPLAY

Above the dashed line, the analyzer will display the trace specification which was used for the measurement. Below the dashed line, the analyzer will list the first 16 lines of information captured into memory. In trace measurements, the trigger word (line on which the trigger appears) will be displayed in inverse video. You may elect to have the analyzer display the information in its memory in the form of op codes and operands in the mnemonics of the microprocessor under test, or you can have the analyzer present the hexadecimal equivalents of the states captured from the address and data buses under test during each qualified clock cycle (absolute display). Press the MNEMONIC/ABSOLUTE key to make this selection.

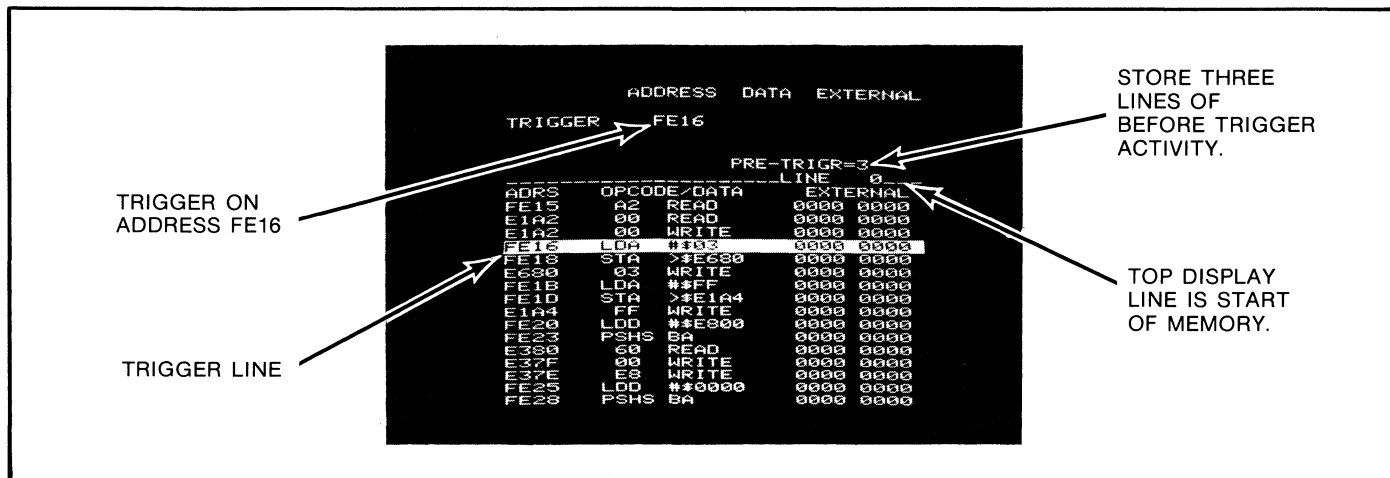


Figure 5-2. Trace Display

THE TRACE DISPLAY. The Trace Display photograph in figure 5-2 shows a great deal about the conditions under which the trace was made. The analyzer was set up with the following trace specifications:

1. Trigger when the analyzer recognizes state FE16 on the address bus. Any states on the data bus and the external lines will qualify as triggers.
2. Store the last three lines of activity before the trigger occurrence. Then store the trigger, and fill

the remaining memory space (60 lines) with the qualified states that follow consecutively after the trigger.

The statement LINE 0 tells us that the analyzer display window is positioned at the start of memory. We can assume that the displayed trace was taken with the CLOCK QUALIFIER switch set to VMA because there are no NON VMA lines in the OPCODE/DATA column.

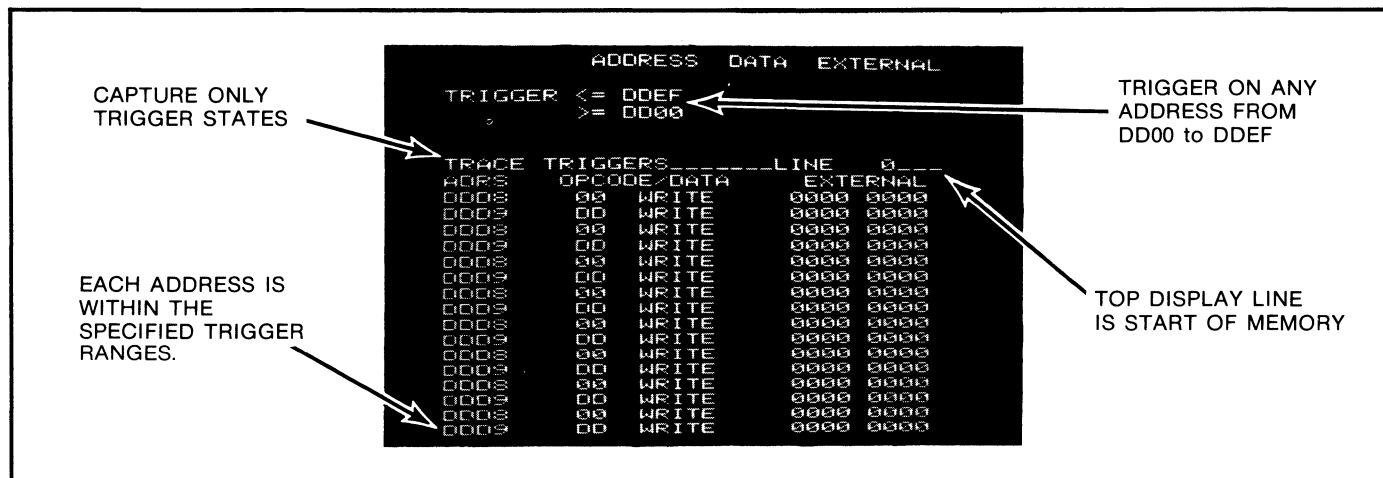


Figure 5-3. Trace Triggers Display

THE TRACE TRIGGERS DISPLAY. The Trace Triggers Display photograph (figure 5-3) shows several items of information about the conditions under which this trace was made. The trigger field shows that the analyzer was set up to recognize as its trigger a range of states on the address bus: from DD00 to DDEF (hex). The statement TRACE TRIGGERS

on the dashed line tells us that the analyzer memory contains only those states that match the specified trigger condition. Any state on the data bus and external lines was accepted as a trigger as long as the associated address word satisfied the trigger requirement.

THE DISPLAY WINDOW. The DISPLAY key group has two keys for rolling a display window through the analyzer memory ($\uparrow$ / $\downarrow$). The analyzer is able to present 16 lines of information at a time on its CRT. To view the entire memory content, you can roll the 16-line display window through the memory using the roll keys. (See figure 5-4.) When the analyzer completes a trace, it presents the first 16 lines of its memory on screen (line 0 through 15). It also places the LINE number of the top line of display in the heading. To view the entire memory content, use the roll keys to roll up and roll down the display. As you roll through memory, the LINE number in the heading will be continuously updated to show the number of the line at the top of the display, keeping you advised of the portion of memory which is being displayed.

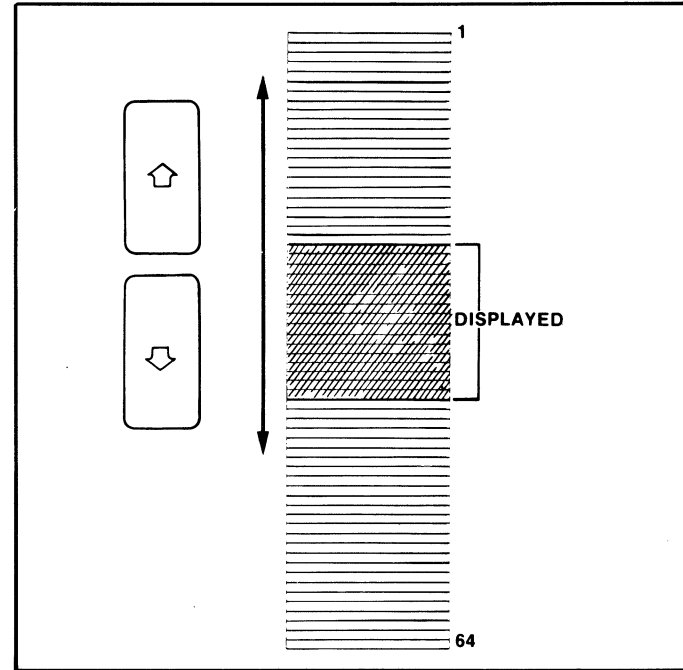


Figure 5-4. Display Window

ABSOLUTE AND MNEMONIC DISPLAYS

The DISPLAY keys of the analyzer keyboard allow you to select either an ABSOLUTE or MNEMONIC presentation of the information captured in the analyzer memory. Each time you press the MNEMONIC/ABSOLUTE key, the format of the display switches from one to the other. During ABSOLUTE and MNEMONIC display modes, the trigger word (line on which the trigger appears) will be shown in inverse video.

ABSOLUTE DISPLAYS. When you select ABSOLUTE displays, the analyzer places each separate transaction captured in memory on a separate line of the display. The analyzer can present 64 display lines if it has a full memory. The hex equivalents of the states captured from the address bus and data bus will be displayed on each line along with a notation describing whether the information represents an OP CODE, a READ, or a WRITE instruction. Refer to table 5-1 for details of these notations.

During those clock periods which are used to perform functions within the microprocessor, the content of the address bus is FFFF. The notation NON VMA will be shown beside the states captured from the buses during these periods. Figures 5-5 through 5-8 show displays taken from the same program flow. The only difference in the two is that the CLOCK QUALIFIER switch was set to VMA for one trace, and turned OFF for the other. The information gathered from the eight EXTERNAL lines is always presented in binary format.

Table 5-1. 6809 Memory Transaction Displays

OPCODE	The content of the data bus is an op-code.
WRITE	The content of the data bus is information being written to memory.
READ	The content of the data bus is being read from memory.
NON VMA	The content of the data bus is unspecified. This clock cycle was used to perform an operation within the microprocessor, and was not used to move data on the buses.

MNEMONIC DISPLAYS. When you select the MNEMONIC display mode, the analyzer reverse assembles the information in its memory and presents machine-language mnemonics along with associated 8-bit or 16-bit operands (when operands exist). Since one program line may be comprised of several memory transactions, the number of lines available for display on the analyzer will probably be less than 64. In these cases, the address displayed on each line will be the address of the activity which began the program instruction. As with the ABSOLUTE mode of display, you can qualify every clock period, or only those clock periods which were used for valid memory access on the address and data buses. Any lines captured during periods which were not used for valid memory access will be designated with address FFFF and NON VMA.

ADDRESS DATA EXTERNAL			
TRIGGER F000			
-----LINE 0-----			
ADDR	OPCODE/DATA	EXTERNAL	
F000	10 OPCODE	0000	0000
F00E	0E OPCODE	0000	0000
F00F	E3 READ	0000	0000
F0E0	80 READ	0000	0000
F0E1	C6 OPCODE	0000	0000
F0E2	02 READ	0000	0000
F0E3	F7 OPCODE	0000	0000
F0E4	F8 READ	0000	0000
F0E5	00 READ	0000	0000
FFFF	00 NON VMA	0000	0000
FS00	02 WRITE	0000	0000
FDE5	8E OPCODE	0000	0000
FDE7	FE READ	0000	0000
FDE8	F5 READ	0000	0000
FDE9	BF OPCODE	0000	0000
FDEA	E0 READ	0000	0000

Figure 5-5. ABSOLUTE Display with
CLOCK QUALIFIER OFF

ADDRESS		DATA	EXTERNAL		
TRIGGER		F000			
-----LINE 0-----					
ADDR	OPCODE/DATA		EXTERNAL		
F000	10	OPCODE	0000	0000	
F00E	CE	OPCODE	0000	0000	
F00F	E3	READ	0000	0000	
F0E0	80	READ	0000	0000	
F0E1	C6	OPCODE	0000	0000	
F0E2	02	READ	0000	0000	
F0E3	F7	OPCODE	0000	0000	
F0E4	F8	READ	0000	0000	
F0E5	00	READ	0000	0000	
FS00	02	WRITE	0000	0000	
FDE5	8E	OPCODE	0000	0000	
FDE7	FE	READ	0000	0000	
FDE8	F5	READ	0000	0000	
FDE9	BF	OPCODE	0000	0000	
FDEA	E0	READ	0000	0000	
FDEB	00	READ	0000	0000	

Figure 5-6. ABSOLUTE Display with
CLOCK QUALIFIER set to VMA

ADDRESS	DATA	EXTERNAL
TRIGGER	F000	
ADDR	OPCODE/DATA	LINE
F000	LDS #F380	0000 0000
F0E1	LDB #F02	0000 0000
F0E3	STB >#F800	0000 0000
FFFF	DD NON UMA	0000 0000
F800	02 WRITE	0000 0000
F0E5	LDX #F0F5	0000 0000
F0E9	STX >#E000	0000 0000
FFFF	DD NON UMA	0000 0000
E000	FE WRITE	0000 0000
E001	F5 WRITE	0000 0000
F0EC	STX >#E002	0000 0000
FFFF	DD NON UMA	0000 0000
E002	FE WRITE	0000 0000
E003	F5 WRITE	0000 0000
F0EF	LDX #F000	0000 0000
F0F2	STX >#E004	0000 0000

Figure 5-7. MNEMONIC Display with
CLOCK QUALIFIER OFF

ADDRESS	DATA	EXTERNAL
TRIGGER	F000	
ADDR	OPCODE/DATA	LINE
F000	LDS #F380	0000 0000
F0E1	LDB #F02	0000 0000
F0E3	STB >#F800	0000 0000
F800	02 WRITE	0000 0000
F0E5	LDX #F0F5	0000 0000
F0E9	STX >#E000	0000 0000
E000	FE WRITE	0000 0000
E001	F5 WRITE	0000 0000
F0EC	STX >#E002	0000 0000
E002	FE WRITE	0000 0000
E003	F5 WRITE	0000 0000
F0EF	LDX #F000	0000 0000
F0F2	STX >#E004	0000 0000
E004	FD WRITE	0000 0000
E005	DD WRITE	0000 0000
F0F5	LDX #F039	0000 0000

Figure 5-8. MNEMONIC Display with
CLOCK QUALIFIER set to VMA

DISPLAY ERROR NOTATION. Stars (***) on the display indicate that insufficient data was captured to allow the analyzer to completely disassemble the associated instruction. If an operand was found in program flow but it was not captured in the analyzer memory, the analyzer will show stars

in the associated line. If an invalid op-code was detected when the analyzer reverse-assembled its memory for the mnemonic display, stars will flash in the line containing that op-code.

SECTION VI

MAKING A COUNT OF TRIGGER OCCURRENCES

INTRODUCTION

The Count Triggers mode is used to count the number of times that your specified trigger word (or range of trigger words) occurs during a run. Normally a count of trigger occurrences is made within a window of program flow, bounded by some selected trigger ENABLE and trigger DISABLE words. This operating mode can be used to count the number of occurrences of a particular word, series of words, or all transactions between and including the ENABLE and DISABLE words. You can use this mode to determine how many times certain transactions occur within a range of program flow. The trigger count can also be made as a continuous-run to determine whether or not the number of transactions between your ENABLE and DISABLE words are stable or whether there may be occasional clock slips (words dropped) or added clocks (invalid words added) between your ENABLE and DISABLE words.

SETUP FOR A COUNT TRIGGERS RUN

1. Connect microprocessor probe A13 to the 6809 microprocessor you are going to test. Use either the method described in paragraph a or b for making these connections:
 - a. Remove microprocessor from circuit or assembly under test and install it in socket on microprocessor probe A13. Then connect cable with 40-pin connectors from microprocessor probe to circuit or assembly where microprocessor was removed.
 - b. If you do not use step a above, leave microprocessor installed in its circuit or assembly. Then connect 40-pin clip from microprocessor probe A13 directly to contact pins on the 6809 assembly.
2. Connect external probe channels to points which are to be monitored or used for trigger qualification, if desired. Each channel can be connected through a separate wire. Be sure to ground the probe through the appropriate wire. The probe channels are numbered on the probe label. These numbers correspond to locations on the analyzer display.
3. Turn on analyzer LINE power switch. The ON lamp should light.

4. Enter the trigger ENABLE and trigger DISABLE words that you will use in making your trigger count. Remember that these two words will be included in your count of triggers if they meet your trigger specification, and will not be included if they are outside of your trigger specification.
5. Enter the trigger desired. You may enter a single word, a range of words, or specify all don't cares. This last entry will tell the analyzer to count every transaction including the ENABLE and DISABLE words. Refer to Section IV for modes of triggering available.
6. Select any mode of clock, trigger, and transaction qualification desired on the personality panel. Refer to Section IV for modes of qualification available.
7. On personality panel A11, set TEST MODE switch to NORMAL. This is the position you should use when making a count triggers measurement.

NOTE

The CLOCK QUALIFIER switch directly affects the number of triggers that will be counted in a count triggers measurement. With a setup of TRIGGER = XXXX, the analyzer will count only the VMA transactions with CLOCK QUALIFIER set to VMA, and all transactions with CLOCK QUALIFIER OFF.

EXECUTING A COUNT TRIGGERS MEASUREMENT

1. Press the COUNT TRIGGERS key on the analyzer keyboard. If you wish to make a continuous-run series of counts, press and hold the COUNT TRIGGERS key until CONTINUOUS appears on the analyzer display, approximately 2 seconds.
2. The message WAITING FOR ENABLE will flash on the analyzer screen until the ENABLE word you entered is found by the analyzer. The bottom line of the display will show COUNT = 0 TRIGGERS.
3. The message on the analyzer display will change to COUNTING after the ENABLE word has been found. The bottom line of the display will change to COUNT=, and the number will be the number of triggers found. This will include the ENABLE word if it meets the trigger specification.

NOTE

The analyzer can count up to $2^{24}-1$ (approximately 16.78×10^6) trigger words. If the counter limit is exceeded before the DISABLE word is found, the message COUNTER OVERFLOW will flash on the display.

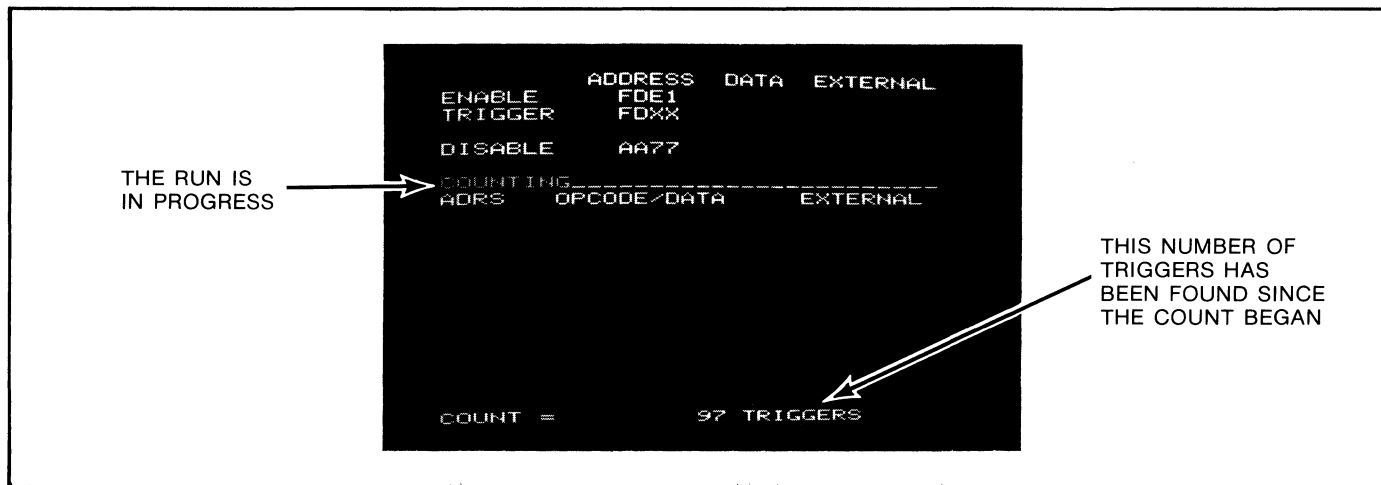


Figure 6-1. Count In Progress

4. If you are making a continuous-run measurement, press TRACE TRIGGERS key again to return to normal operation.
5. When the DISABLE word is detected, the analyzer will complete the measurement. The message COUNT = will disappear from the bottom of the display. Refer to the Interpretation of Display paragraph.
6. The count triggers measurement can be stopped at any time by pressing the STOP key, or aborted by pressing any other key. When the STOP key is pressed during a run, the message STOPPED will appear on the analyzer display.

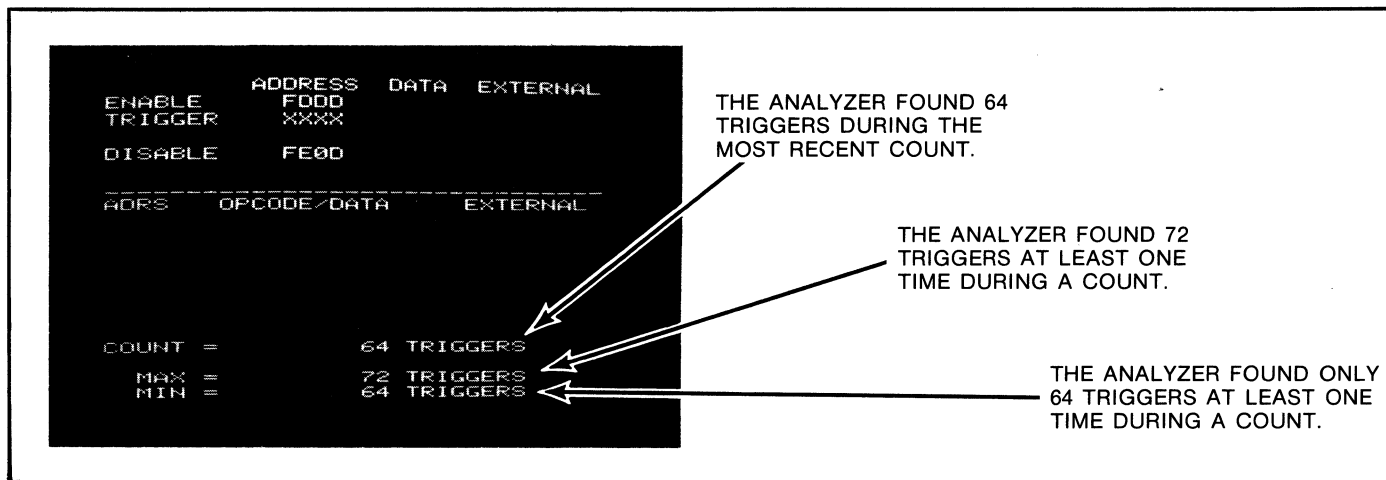


Figure 6-2. Interpreting The Count Triggers Display

INTERPRETING THE COUNT TRIGGERS DISPLAY

At the end of a run, the Count Triggers display will show three counts: COUNT =, MAX =, and MIN =. These three counts will all be the same after you have run only one count. But these three fields are very useful when you are making a continuous-run test or a series of counts. In such a test, the three fields may have three different numbers.

The COUNT = field will show the number of triggers counted during the most recently completed run.

The MAX = field will show the most triggers that were found during any of the count periods.

The MIN = field will show the least triggers that were found during any of the count periods.

SECTION VII

MEASURING TIME INTERVALS IN PROGRAM FLOW

INTRODUCTION

The Time Interval mode is used to measure time periods within a window of program flow bounded by selected trigger ENABLE and trigger DISABLE words. This operating mode can be used to verify the execution time of a wait loop. It can also be used to measure the execution time of a subroutine where a critical timing interface is required by the system hardware or an external device. Time interval measurements can be made as a continuous-run to measure deviations in program execution times. The analyzer makes time interval measurements with reference to its own internal clock. Its clock runs at 1-MHz and is accurate within 0.1% +1 μ sec.

SETUP FOR A TIME INTERVAL MEASUREMENT

1. Connect microprocessor probe A13 to the 6809 microprocessor you are going to test. Use either method a or method b described below for making these connections:
 - a. Remove microprocessor from circuit or assembly under test and install it in socket on microprocessor probe A13. Then connect cable with 40-pin connectors from microprocessor probe to circuit or assembly where microprocessor was removed.
 - b. If you do not use step a, leave microprocessor installed in its circuit or assembly. Then connect 40-pin clip from microprocessor probe A13 directly to contact pins on the 6809 assembly.
2. Connect external probe channels to points which are to be monitored or used for trigger qualification, if desired. Each channel can be connected through a separate wire. Be sure to ground the probe through the appropriate wire. The probe channels are numbered on the probe label. These numbers correspond to locations on the analyzer display.
3. Turn on analyzer LINE power switch. The ON lamp should light.
4. Enter the trigger ENABLE and trigger DISABLE words that define the boundaries for your time interval measurement. The count will begin when the analyzer detects the ENABLE word and will end when the analyzer detects the DISABLE word.
5. Do not enter a trigger word. It will not be used in this measurement.

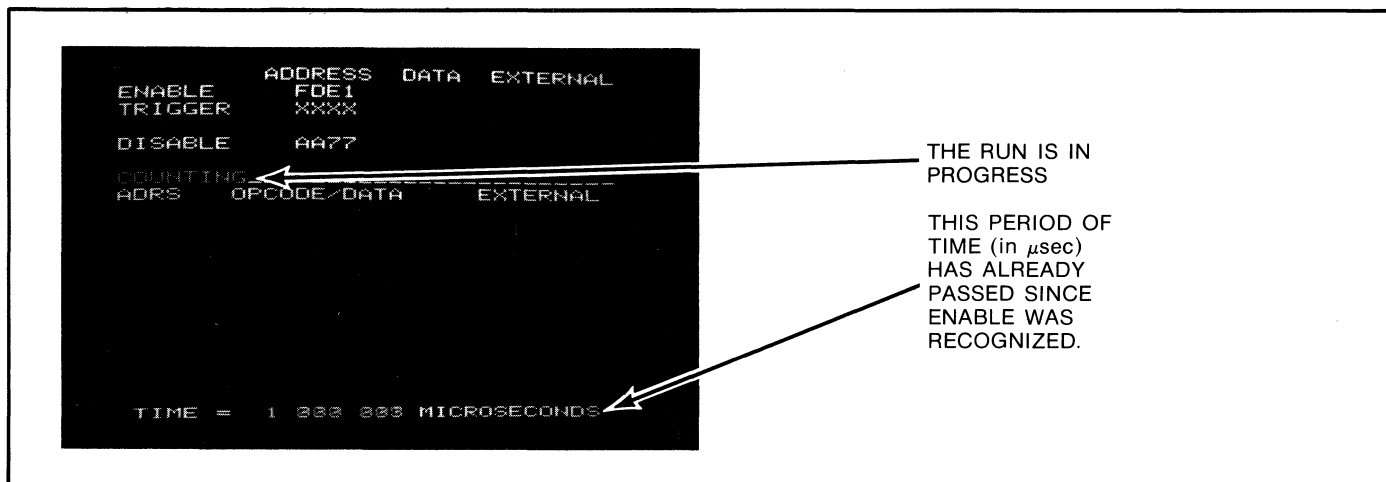


Figure 7-1. Time Measurement in Progress

6. Select any mode of qualification desired for your ENABLE and DISABLE words by using the switches on the personality panel. Refer to Section IV for modes of qualification available.
7. On personality panel A11, set TEST MODE switch to NORMAL. This is the position you should use when making a time interval measurement.

EXECUTING A TIME INTERVAL MEASUREMENT

1. Press the TIME INTRVL key on the analyzer keyboard. If you wish to make a continuous-run series of counts, press and hold the TIME INTRVL key until CONTINUOUS appears on the analyzer display, approximately 2 seconds.

2. The message WAITING FOR ENABLE will flash on the analyzer screen until the ENABLE word you entered is found by the analyzer. The bottom line of the display will show TIME = 0 MICROSECONDS.
3. The message on the analyzer display will change to COUNTING after the ENABLE word has been found. The bottom line of the display will change to TIME =, and the number will be the elapsed time since the ENABLE word was found, in microseconds.

NOTE

The analyzer can count up to $2^{24} \times 1$ microseconds (approximately 16 seconds). If the counter limit is exceeded before the DISABLE word is found, the

message COUNTER OVERFLOW will flash on the screen.

4. If you are making a continuous-run measurement, press TIME INTRVL key again to return to normal operation.
5. When the DISABLE word is detected, the measurement is completed. The message TIME = will disappear from the bottom of the display. Refer to the interpretation of Display paragraph.
6. The time interval measurement can be stopped at any time by pressing the STOP key, or aborted by pressing any other key. When the STOP key is pressed during a run, the message STOPPED will appear on the analyzer display.

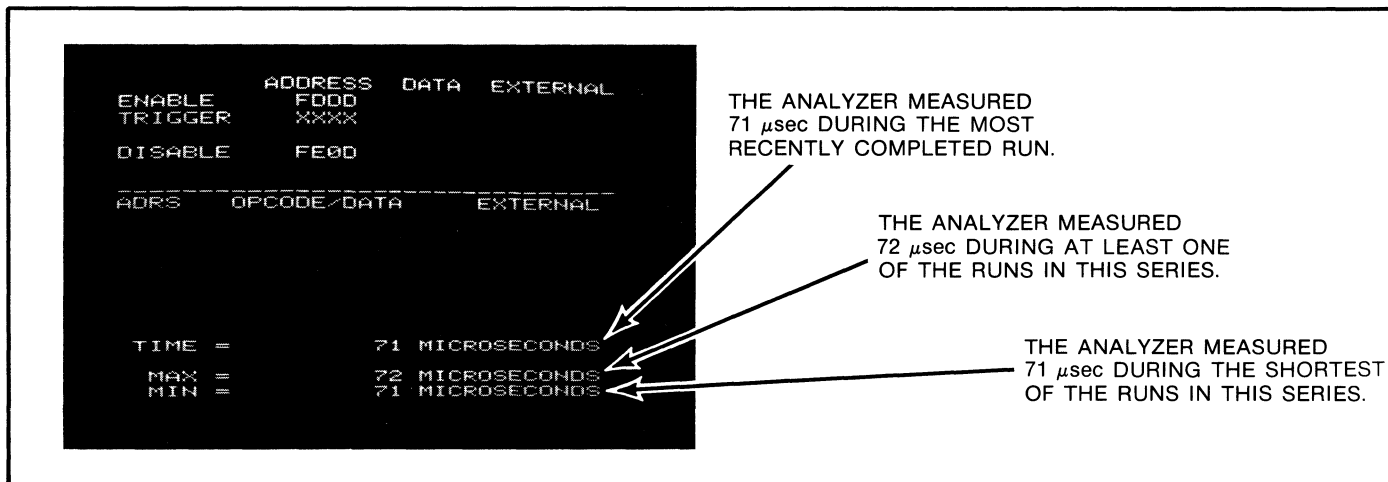


Figure 7-2. Interpreting The Time Interval Display

INTERPRETING THE TIME INTERVAL DISPLAY

At the end of a run, the time interval display will show three counts: TIME =, MAX =, and MIN =. After the first measurement is completed, (ENABLE and DISABLE both found), all three fields will have the same count of time. In a test consisting of a series of counts, these three fields may all have different values. After such a test, interpret the fields as follows:

The TIME = field will show the time period measured in the most recent measurement.

The MAX = field will show the longest time period that was measured during any of the measurements in the series.

The MIN = field will show the shortest time period that was measured during any of the measurements in the series.

SECTION VIII

OPERATING TESTS

INTRODUCTION

This section describes a series of tests that you can make on the analyzer without the need of any extra test equipment. These tests do not check analyzer operations against the published specifications, but if your analyzer does pass all of these tests, you can be reasonably sure that it is performing according to its specifications.

NOTE

There is no accommodation built into the analyzer for checking proper operation of the CLOCK QUALIFIER switch. The only check you can make of this switch is to observe the results as you use it during a measurement of program flow in a system under test.

Perform all of these tests in sequence. The results obtained from any one test may depend upon connections and switch settings made in a previous test.

SELF TEST

The analyzer automatically performs this test each time you turn on operating power. It verifies proper operation of the ROM, display RAM, and some hardware circuits. When the analyzer passes this test, it will place the message SELF TEST COMPLETED on its display. If the ROM, RAM, or hardware tests fail, the analyzer will place a message on the CRT that indicates the cause of the failure. To perform the self test, proceed as follows:

1. Connect the analyzer to operating power.
2. Turn on the LINE power switch.
3. Verify that the analyzer CRT displays SELF TEST COMPLETED.

INDICATOR LIGHTS TEST

These tests check for proper operation of the indicator lights on the analyzer. To check the indicator lights, proceed as follows:

1. Connect microprocessor probe A13 to the PROBE TEST socket on the personality panel. Make sure that your pin orientation is correct.
2. Ensure that the POWER ON lamp is lit beside the LINE switch.
3. Set the TEST MODE switch to NORMAL.
4. See that the NO CLOCK, HALTED, WAITING FOR INTERRUPT, and SYNCING lamps light in sequence on the personality panel.
5. Set the TEST MODE switch to TRACE SINGLE STEP. The HALTED BY 1611A lamp should light.
6. Return the TEST MODE switch to NORMAL.
7. Check the TRIGGER QUALIFIER light by turning the WRITE, READ OP CODE, and READ OP CODE switches on and off. All three switches must be off for the TRIGGER QUALIFIER light to be out.

PROBE TEST

This test verifies proper connection and operation of the address, data, and control lines in the microprocessor probe. It also verifies the ability of the analyzer to recognize a WRITE-qualified trigger on the address bus. To perform this test, proceed as follows:

1. Set switches on the personality panel as follows:

CLOCK QUALIFIER	OFF
READ OP CODE	OFF
READ OP CODE	OFF
WRITE	WRITE
TEST MODE	NORMAL

2. Press the TRIGGER/ADDRESS BUS = key.
3. Enter 0000. This is the lowest address in the analyzer PROBE TEST routine.
4. Press the analyzer TRACE key. The analyzer should present a display like the one shown in the associated photograph.

ADDRESS DATA EXTERNAL			
TRIGGER 0000			
-----LINE 0-----			
ADDR	OPCODE/DATA	EXTERNAL	
0000	00 WRITE	0000	0000
1111	11 WRITE	0000	0000
2222	22 WRITE	0000	0000
3333	33 WRITE	0000	0000
4444	44 WRITE	0000	0000
5555	55 WRITE	0000	0000
6666	66 WRITE	0000	0000
7777	77 WRITE	0000	0000
8888	88 WRITE	0000	0000
9999	99 WRITE	0000	0000
AAAA	AA WRITE	0000	0000
BBBB	BB WRITE	0000	0000
CCCC	CC WRITE	0000	0000
DDDD	DD WRITE	0000	0000
EEEE	EE WRITE	0000	0000
FFFF	FF WRITE	0000	0000

Figure 8-1. Normal Probe Test Display

MEMORY DISPLAY TEST

This test verifies that the information stored in the analyzer memory can be viewed through a 16-line movable window, and that the analyzer can present both an absolute and a mnemonic display of captured information.

1. Use the roll ($\uparrow$ / $\downarrow$) keys to scroll through memory.
2. Verify that the entire memory range can be displayed (LINE 0 through LINE 48 on dashed divider line of display).
3. Turn off the WRITE switch.
4. Set the READ OP CODE switch to OP CODE.
5. Press the analyzer TRACE key. The analyzer should present a display like the one shown in figure 8-2. Press the MNEMONIC/ABSOLUTE key and make sure that the analyzer will present both the mnemonic and the absolute displays, as shown in figure 8-2.

ADDRESS		DATA	EXTERNAL
TRIGGER		0000	
-----LINE 0-----			
ADDR	OPCODE/DATA	EXTERNAL	
0000	NEG 0000	0000	0000
1111	11 WRITE	0000	0000
2222	22 WRITE	0000	0000
3333	33 WRITE	0000	0000
4444	44 WRITE	0000	0000
5555	55 WRITE	0000	0000
6666	66 WRITE	0000	0000
7777	77 WRITE	0000	0000
8888	88 WRITE	0000	0000
9999	99 WRITE	0000	0000
AAAA	AA WRITE	0000	0000
BBBB	BB WRITE	0000	0000
CCCC	CC WRITE	0000	0000
DDDD	DD WRITE	0000	0000
EEEE	EE WRITE	0000	0000
FFFF	FF WRITE	0000	0000

MNEMONIC
Test Display

ADDRESS DATA EXTERNAL			
TRIGGER 0000			
-----LINE 0-----			
ADDR	OPCODE/DATA	EXTERNAL	
0000	00 OPCODE	0000	0000
1111	11 WRITE	0000	0000
2222	22 WRITE	0000	0000
3333	33 WRITE	0000	0000
4444	44 WRITE	0000	0000
5555	55 WRITE	0000	0000
6666	66 WRITE	0000	0000
7777	77 WRITE	0000	0000
8888	88 WRITE	0000	0000
9999	99 WRITE	0000	0000
AAAA	AA WRITE	0000	0000
BBBB	BB WRITE	0000	0000
CCCC	CC WRITE	0000	0000
DDDD	DD WRITE	0000	0000
EEEE	EE WRITE	0000	0000
FFFF	FF WRITE	0000	0000

ABSOLUTE
Test Display

Figure 8-2. MNEMONIC/ABSOLUTE Test Displays

TRACE MODE STATUS MESSAGES TEST

This test verifies the ability of the analyzer to display WAITING FOR ENABLE until it finds the ENABLE specification, and WAITING FOR TRIGGER until it finds the TRIGGER specification. To perform this test, proceed as follows:

1. Press the TRIGGER ENABLE/ADDRESS BUS = key.
2. Enter CDEF. This address never occurs in the PROBE TEST routine.
3. Press the TRACE key. Verify that WAITING FOR ENABLE is flashing.
4. Press the TRIGGER ENABLE/ADDRESS BUS = key.
5. Press DON'T CARE.
6. Press the TRIGGER/ADDRESS BUS = key.
7. Enter CDEF.
8. Press the TRACE key. Verify that WAITING FOR TRIGGER is flashing.

TRIGGER SPECIFICATIONS TESTS

This test verifies the ability of the analyzer to recognize trigger specifications involving address ranges, trigger occurrence counts, and clock delays. This test also verifies the ability of the analyzer to capture only trigger words during TRACE TRIGGERS runs.

1. Turn off the READ OP CODE switch.
2. Press the ADRS BUS $\geq$ key.
3. Enter 0000.
4. Press the ADRS BUS $\leq$ key.
5. Enter 1110. The first steps of this procedure allow the analyzer to recognize address 0000 in the PROBE TEST routine.
6. Press the TRIGGER OCCURRENCE key.
7. Enter 256. This tells the analyzer to trigger on the 256th occurrence of its trigger word.
8. Press the AFTER TRIG key.

9. Enter 65472. This tells the analyzer to wait 65472 transactions after it recognizes its trigger before it acquires its trace.
10. Press the TRACE key several times. The following two status messages will flash during some of the runs. WAITING FOR TRIGGER will flash until the trigger is recognized, and DELAYING will flash until the trace is completed (LINE 0 displayed). The internal operation of the analyzer is so fast that these messages may not flash during every run.
11. On the personality panel, set the WRITE TRIGGER QUALIFIER switch to WRITE.
12. Press the TRACE TRIGS key. Verify that every row of data displayed shows that only triggers were captured in memory: 0000 00 WRITE 0000 0000
13. Turn off the WRITE switch.

TRACE TRIGGERS END ON DISABLE MODE TEST

This test checks the ability of the analyzer to execute a TRACE TRIGS run and terminate the run when it detects a DISABLE word. To perform this test, proceed as follows:

1. Press and hold the DON'T CARE key approximately 3 seconds until all TRACE SPECIFICATIONS are cleared.

2. Press the TRIGGER/ADRS BUS $\geq$ key.
3. Enter 0000.
4. Press the TRIGGER/ADRS BUS $\leq$ key.
5. Enter EEEE. The first steps of this procedure set up the analyzer to recognize 15 of the 16 addresses in the PROBE TEST routine.
6. Press the BEFORE TRIG key.
7. Enter 63.
8. Press the TRIGGER DISABLE/ADDRESS BUS = key.
9. Enter ABAB. (This state never occurs during the PROBE TEST routine.)
10. Press the TRACE TRIGS key.
11. Verify that TRIGR OCCUR $\Rightarrow$ 64 flashes.
12. Press the TRIGGER DISABLE/ADDRESS BUS = key.
13. Enter FFFF. (This is the highest address state in the test program.)
14. Press the TRACE TRIGS key several times.

15. Verify that the analyzer display shows only one series of test states in memory, ending with EEEE. You have set the analyzer to recognize all of the states in the internal test program from 0000 through EEEE. The content of the analyzer memory, after any one run, will depend upon which state the analyzer was executing when you pressed the TRACE TRIGS key. These states will lead up to FFFF, where the analyzer run will be disabled. The DISABLE state will not be captured in memory since it does not meet the trigger specification.

NOTE

If the serial prefix of your analyzer is below 1723A, and if you have not modified the analyzer to perform this mode, then TRIGR OCCUR = 64 will be displayed immediately.

PRETRIGGER TEST

This test checks the ability of the analyzer to capture and display a specified number of transactions before it accepts the trigger word. To perform this test, proceed as follows:

1. Press and hold the DON'T CARE key for approximately 3 seconds until all TRACE SPECIFICATIONS are cleared.

2. Press the TRIGGER/ADDRESS BUS = key.
3. Enter AAAA.
4. Press the BEFORE TRIG key.
5. Enter 4.
6. Press the TRACE key several times. The trigger word, AAAA in inverse video, will usually be located on the fifth line of the display, preceded by four states of pretrigger. In some cases, the trigger word will not be on the fifth line of the display. This is because of the way the analyzer executes a run which has a before-trigger specification. In such a run, the analyzer counts the number of states that it captures after (not before) the trigger. With a pretrigger of four, the analyzer will accept all states into its memory until it recognizes the trigger. Then it will count the trigger as 1, and capture the next 59 states. This usually places four states of pretrigger in memory ($4+1+59=64$). If the trigger state is found before the fifth state, the analyzer will still capture the trigger and the next 59 states, but this time you will see less than four states of pretrigger information on the display. To verify the cause when you obtain a display with less than the specified number of lines of pretrigger, use the roll keys to roll up to the end of memory. There will be less than 64 states captured in memory (less than LINE 48 on the top of the display).

COUNT TRIGGERS MODE TEST AND STOP TEST

This test checks the ability of the analyzer to count triggers occurring between any selected ENABLE and DISABLE words. This test also checks for normal response to the analyzer STOP key. To perform this test, proceed as follows:

1. Press and hold the DON'T CARE key for approximately 3 seconds until all TRACE SPECIFICATIONS have been cleared.
2. Press the TRIGGER ENABLE/ADDRESS BUS = key.
3. Enter 0000.
4. Press the TRIGGER DISABLE/ADDRESS BUS = key.
5. Enter FFFF.
6. Press the TRIGGER/ADDRESS BUS = key.
7. Enter 4444.
8. Press and hold the COUNT TRIGS key for approximately 3 seconds until the CONTINUOUS message is displayed.
9. Press the STOP key and verify that STOPPED is displayed. The COUNT =, MAX =, and MIN = fields should all display 1 TRIGGERS. The continuously

updated message COUNT = may be on the bottom of the screen, depending upon the address that was being executed when you pressed the STOP key.

TIME INTERVAL MODE TEST

This test verifies proper analyzer operation in the time interval mode. It verifies that the analyzer will measure time intervals between selected ENABLE and DISABLE words on the data bus, and that the message COUNTER OVERFLOW will be displayed if the analyzer does not complete its count in less than approximately 16 seconds. To perform this test, proceed as follows:

1. Press and hold the DON'T CARE key approximately 3 seconds until all TRACE SPECIFICATIONS are cleared.
2. Press the TRIGGER ENABLE/DATA BUS = key.
3. Enter 00.
4. Press the TRIGGER DISABLE/DATA BUS = key.
5. Enter FF.
6. Press and hold the TIME INTVL key for approximately 3 seconds until the CONTINUOUS message is displayed. Verify that TIME =, MAX =, and MIN = all display 15 microseconds (± 1).

7. Press the TRIGGER DISABLE/DATA BUS = key.
8. Enter AB.
9. Press the TIME INTVL key. Verify that COUNTING, followed by COUNTER OVERFLOW are displayed (flashing).

TRIGGER QUALIFIER SWITCHES TEST

This test verifies the ability of the TRIGGER QUALIFIER switches to restrict analyzer triggering to certain types of machine cycles. To perform this test, proceed as follows:

1. Press and hold the DON'T CARE key approximately 3 seconds until all TRACE SPECIFICATIONS are cleared.
2. Press the TRACE key. Verify that a list is displayed.

3. Set the WRITE TRIGGER QUALIFIER switch to WRITE.
4. Press the TRACE key. Verify that the trigger line (in inverse video) displays WRITE in the OPCODE/DATA column.
5. Return the WRITE switch to OFF.
6. Set the READ $\overline{\text{OP CODE}}$ switch to $\overline{\text{OP CODE}}$.
7. Press the TRACE key. Verify that WAITING FOR TRIGGER is displayed.
8. Return the READ $\overline{\text{OP CODE}}$ switch to OFF.
9. Set the READ OP CODE switch to OP CODE.
10. Press the TRACE key. Verify that the analyzer shows a display like figure 8-2.
11. Return the READ OP CODE switch to OFF.

APPENDIX A

ANALYZER STATUS MESSAGES

The following messages are displayed on the analyzer screen to provide an indication of analyzer operating status. Messages may vary with different analyzer options.

CONTINUOUS: Appears after an EXECUTE key has been held down approximately 2 seconds. This initiates continuous-run execution of the selected mode. Single-run operation can be restored by pressing the same key briefly. Continuous operation can also be stopped by pressing the STOP key or aborted by pressing any other key.

COUNTER OVERFLOW: Appears during COUNT TRIGS or TIME INTERVAL measurements when the capacity of the event counter is exceeded (count exceeds $2^{24}-1$).

COUNTING: Appears in COUNT TRIGS or TIME INTERVAL measurements when the analyzer is in the process of counting.

DELAYING: Displayed in TRACE mode from the time TRIGGER OCCURRENCE specification has been met until the measurement is complete.

ERROR IN HARDWARE: Displayed when analyzer self-test has detected a malfunction in its internal hardware.

ERROR IN RAM/ROM: Appropriate message appears after turn-on if analyzer self-test determines that random-access memory or read-only memory is not functioning correctly.

ILLEGAL CHARACTER: Appears if the operator attempts to enter an invalid character into an open trace specification field. For example, attempting to enter an alpha character in the BEFORE TRIG field (decimal field) will generate this message.

LINE 0-48: Indicates number of line at the top of the data display in TRACE and TRACE TRIGS modes. When LINE 48 is displayed, the next 15 lines on the display complete the 64 lines (0 to 63) stored in memory.

NO OPEN DATA FIELD: Displayed when the operator tries to enter a character from the ENTRY keys without pressing an appropriate TRACE SPECIFICATION key to open a field.

RUN ABORTED, NO DISPLAY CHANGE: Displayed in two conditions:

1. If a DISPLAY key is pressed when a TRACE or TRACE TRIGS run is in progress.
2. If a DISPLAY key is pressed after a previous TRACE or TRACE TRIGS measurement was aborted.

SELF-TEST COMPLETED: Indicates satisfactory completion of self-test (unless an error message is also displayed).

SINGLE STEP: Displayed after TRACE is pressed during a single-step measurement.

SINGLE STEP, NO DISPLAY CHANGE: Displayed after a trace has been executed in TRACE SINGLE STEP test mode if you try to change the display using the DISPLAY keys.

SINGLE STEP, TRACE ONLY: Displayed when TEST MODE switch is set to SINGLE STEP and you press TRACE TRIGS, COUNT TRIGS, or TIME INTRVL key. Only TRACE can be executed in SINGLE STEP test mode.

STOPPED: Displayed after STOP key has been pressed; indicates the run in progress has been halted.

TRIGR OCCUR=: Displayed in three conditions:

1. During TRACE measurements which include a trigger occurrence specification, from first trigger recognition until number of triggers recognized equals number specified.
2. During TRACE TRIGS measurements, from first trigger recognition until display memory is full (64 triggers stored).
3. During TRACE TRIGS END ON DISABLE measurements. TRIGR OCCUR=0 is displayed until first trigger is found. TRIGR OCCUR =>64 is displayed if 64 triggers are found before the DISABLE word is found, or if the analyzer does not contain the TRACE TRIGGERS END ON DISABLE hardware modifications (Model 1611A Serial Prefixed below 1723A).

NOTE

If TRACE TRIGGERS END ON DISABLE mode is desired, the old A8 board (01611-66508) may be changed to A8 board (01611-66535).

WAITING FOR ENABLE: Only displayed when a trigger ENABLE word has been specified and one of three conditions exists:

1. ENABLE specification has not been met.
2. System under test is running poorly or not at all.
3. Alternates with WAITING FOR TRIGGER if trigger is not found between trigger ENABLE and DISABLE specifications. When the DISABLE is found, the search for ENABLE is resumed.

WAITING FOR TRIGGER: Displayed in two conditions:

1. During TRACE and TRACE TRIGS measurements after trigger ENABLE specification has been met (if ENABLE was specified), but before the first trigger has been found.
2. ENABLE has not been specified, and system under test is running poorly or not at all.



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I-95126 **CATANIA**
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C,P

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVIGLIO**
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Telex: 334632
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Hewlett-Packard Italiana S.p.A.
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Capodimonte, 62/A
I-80131 **NAPOLI**
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A,C,M,CS,E

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
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E,C

Hewlett-Packard Italiana S.p.A.
Via Turazza 14
I-35100 **PADOVA**
Tel: (49) 664888
Telex: 430315
A,C,M,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA**
Tel: (06) 54831
Telex: 610514
A,C,M,CS,E,MS,P*

Hewlett-Packard Italiana S.p.A.
Corso Giovanni Lanza 94
I-10133 **TORINO**
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Telex: 221079
CM,CS,E

JAPAN

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho
ATSUGI, Kanagawa 243
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CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
3-30-18 Tsuruya-cho
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KANAGAWA, 221
Tel: (045) 312-1252
Telex: 382-3204 YHP YOK
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
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69 Kyo-Machi Ikuta-Ku
KOBE CITY 650 Japan
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
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CM,CS,E

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Yokogawa-Hewlett-Packard Ltd.
Sumitomo Seimei Bldg.
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Nakamura-ku
NAGOYA, Aichi 450
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CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.
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AMMAN
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Telex: 21456 SABCO JO
E,M,P

KOREA

Samsung Electronics
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Young Deung Po Ku,
SEOUL
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Telex: SAMSAN 27364
A,C,E,M,P

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P.O. Box 830 Safat
KUWAIT
Tel: 42-4910, 41-1726
Telex: 2481 Areeg KI
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Photo & Cine Equipment
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KUWAIT
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Telex: 2247 Matin
P

LUXEMBOURG

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Blvd de la Woluwe, 100
Woluwe-dal
B-1200 BRUSSELS
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Telex: 23-494 paloben bru
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Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
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KUALA LUMPUR
Tel: 483544
Telex: MA31011
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Protel Engineering
P.O. Box 1917
Lot 319, Satok Road
Kuching, **SARAWAK**
Tel: 53544
Telex: MA 70904 PROMAL
Cable: PROTELENG
A,E,M

MEXICO

Hewlett-Packard Mexicana, S.A. de
C.V.
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Tepepan, Xochimilco
MEXICO CITY 23, D.F.
Tel: (905) 676-4600
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A,C,P,E,MS,P

Hewlett-Packard Mexicana, S.A. de
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Rio Volga 600
Colonia del Valle
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CS

MOROCCO

Dolbeau
81 rue Karatchi
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Telex: 23051, 22822
E

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CASABLANCA
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Telex: 23 739
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MAPUTO
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Telex: 6-203 NEGON Mo
Cable: NEGON
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CM,CP,E,P

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A,M

Northrop Instruments & Systems
Ltd.
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A,M

Northrop Instruments & Systems
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A,M

NIGERIA

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Telex: 31231 TEL NG
A,E,M,P

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Ltd.
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Mushin, **LAGOS**
A,E,M,P

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M

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N-5033 **FYLLINGSDALEN (BERGEN)**
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Hewlett-Packard Norge A/S
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Arranged alphabetically by country



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Telex: 3289 BROKER MB MUSCAT
P

PAKISTAN

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10, Bazar Road
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Tel: 28624
Cable: FEMUS Rawalpindi
A,E,M

Mushko & Company Ltd.
Doshman Chambers
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KARACHI 0302

Tel: 511027, 512927
Telex: 2894 MUSHKO PW
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A,E,M,P*

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Panama 5
Calle Samuel Lewis
Edificio "Alta" No. 2
CIUDAD DE PANAMA
Canal Zone
Tel: 64-2700
Telex: 3480380
Cable: ELECTRON Panama
A,E,M

Foto Internacional, S.A.
P.O. Box 2068

Free Zone of Colon
COLON 3

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Telex: 3485126
Cable: IMPORT COLON/Panama
P

PERU

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S.A.
Los Flamencos 145, San Isidro
Casilla 1030

LIMA 1

Tel: 41-4325
Telex: Pub. Booth 25424 SISIDRO
Cable: ELMED Lima
A,E,M

PHILIPPINES

The Online Advanced Systems
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P.O. Box 1510
Metro MANILA

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A,C,E,M

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P

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P

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P.O. Box 2531
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A,C,E,P

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Intercambio Mundial de Comércio
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138
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M

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A CP

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Telex: 4439 NASSER
M

Scitecharabia
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!DOHA
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P

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Modern Electronic Establishment
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AL-KHOBAR
Tel: 44-678, 44-813
Telex: 670136
Cable: ELECTA AL-KHOBAR
C,E,M,P

Modern Electronic Establishment
P.O. Box 1228, Baghdadiah Street
JEDDAH
Tel: 27-798
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C,E,M,P

Modern Electronic Establishment
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C,E,M,P

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CM,CS

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CAPE PROVINCE 7450
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Hewlett-Packard España S.A.
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Hewlett-Packard Española S.A.

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Hewlett-Packard Española S.A.
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A,CM

Hewlett-Packard (Schweiz) AG
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CH-1202 GENEVA
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Hewlett-Packard (Schweiz) AG
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SYRIA

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DAMASCUS

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Cable: ELECTROBRO DAMASCUS
E

Sawah & Co.

Place Azmé
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DAMASCUS

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Telex: 11304 SATACO SY
Cable: SAWAH, DAMASCUS
M

TAIWAN

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CS,E,MS,P

Hewlett-Packard Far East Ltd.
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Telex: TH81160, 82938, 81038
Cable: UNIMESA Bangkok
A,E,M

Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
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Tel: 234-8670, 234-8671,
234-8672
Cable: BUSIQUIPT Bangkok
P

TRINIDAD & TOBAGO

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Caribbean Telecoms Ltd.
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Arranged alphabetically by country

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E,P

Corema
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TUNIS
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Telex: 12319 CABAM TN
M

TURKEY

Teknim Company Ltd.
Riza Sah Pehlevi
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Kavaklıdere, ANKARA
Tel: 275800
Telex: 42155
E

EMA, Muhendislik Kollektif Sirketi
Mediha Eldem
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YUKsel Caddesi, ANKARA
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Cable: Ematrade
M

UNITED ARAB EMIRATES

Emilac Ltd.
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SHARJAH
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UNITED KINGDOM

see: GREAT BRITAIN

NORTHERN IRELAND

SCOTLAND

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Hewlett-Packard Co.
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HUNTSVILLE, AL 35802
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CM,CS**

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Hewlett-Packard Co.
2424 East Aragon Road
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Hewlett-Packard Co.
P.O. Box 5646
Brady Station
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664-8773
CM,MS

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A,CM,CP,E,P

Hewlett-Packard Co.
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FRESNO, CA 93711
Tel: (209) 224-0582
CM,MS

Hewlett-Packard Co.
1430 East Orangethorpe
FULLERTON, CA 92631
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CM,CP,E,MP

Hewlett-Packard Co.
5400 W. Rosecrans Boulevard
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CM,CP,MP

Hewlett-Packard Co.
3939 Lankershim Blvd.
NORTH HOLLYWOOD, CA 91604
Tel: (213) 877-1282
regional headquarters
CM,C*,E*,MS**

Hewlett-Packard Co.
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CM,CP,E

Hewlett-Packard Co.
646 W. North Market Boulevard
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,CM,CP,E,MS

Hewlett-Packard Co.
9606 Aero Drive
P.O. Box 23333
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Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95050
Tel: (408) 988-7000
A,CM,CP,E,MP

Hewlett-Packard Co.
454 Carlton Court
SO. SAN FRANCISCO, CA 94080
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CM,CP

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
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A,CM,CP,E,MS

Connecticut

Hewlett-Packard Co.
47 Barnes Industrial Road South
P.O. Box 5007
WALLINGFORD, CT 06492
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FORT LAUDERDALE, FL 33309
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CM,CP,E,MP

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